



CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

# Study for Grand Canyon Working Group

## Impact on Restricting Flights from Grand Canyon Airspace

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*September 2006*



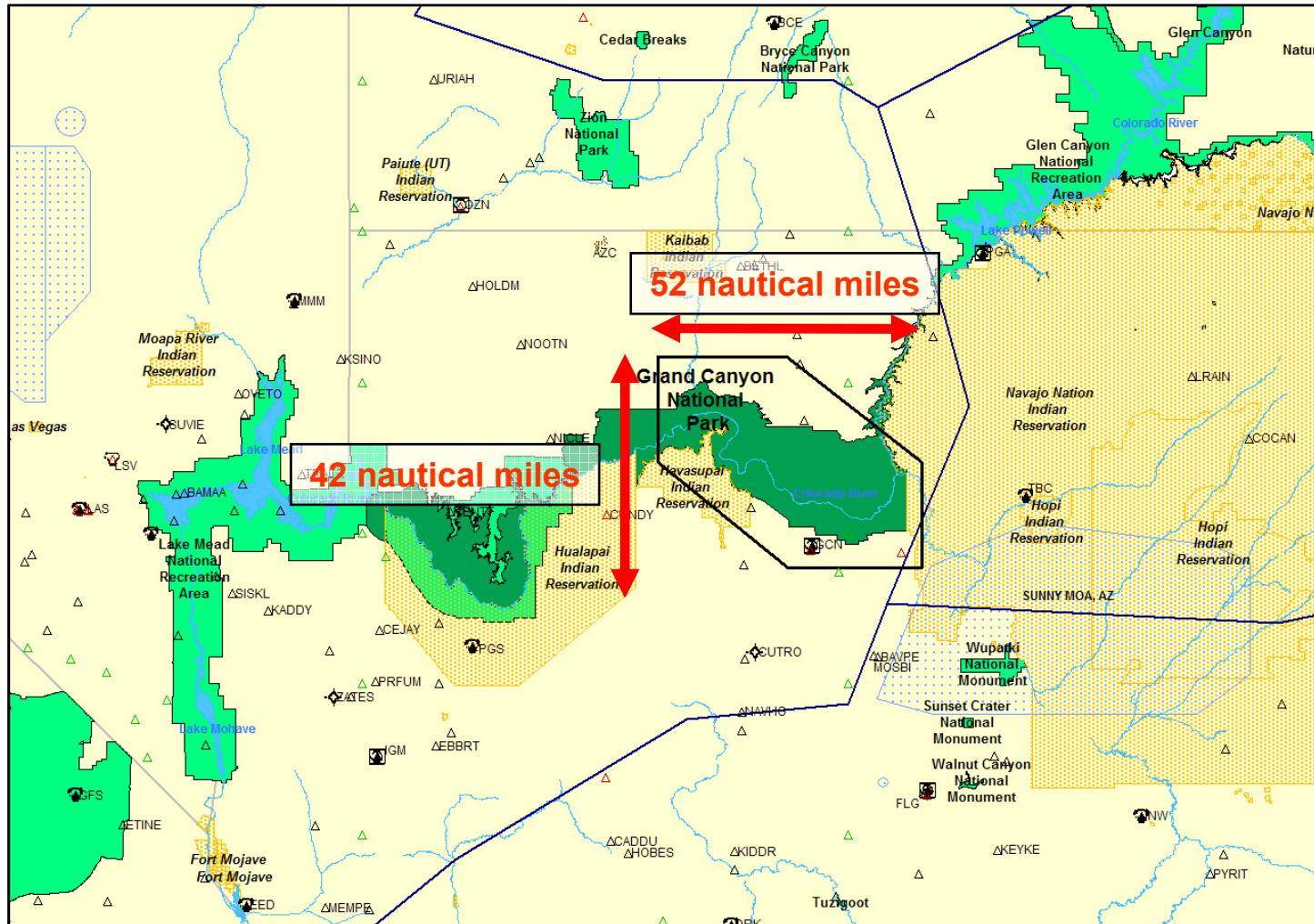
# Background

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- **A flight-free zone over the heart of the Grand Canyon National Park (18,000 ft and above) has been evaluated**
- **MITRE CAASD has been asked to assess impact of restricting flights**
  - **Area where flights are restricted defined by members of Grand Canyon Working Group**
  - **Several traffic scenarios, also defined by members of Grand Canyon Working Group**



# Study Area



For Internal Grand Canyon Workgroup Discussion Only



# Traffic Scenarios

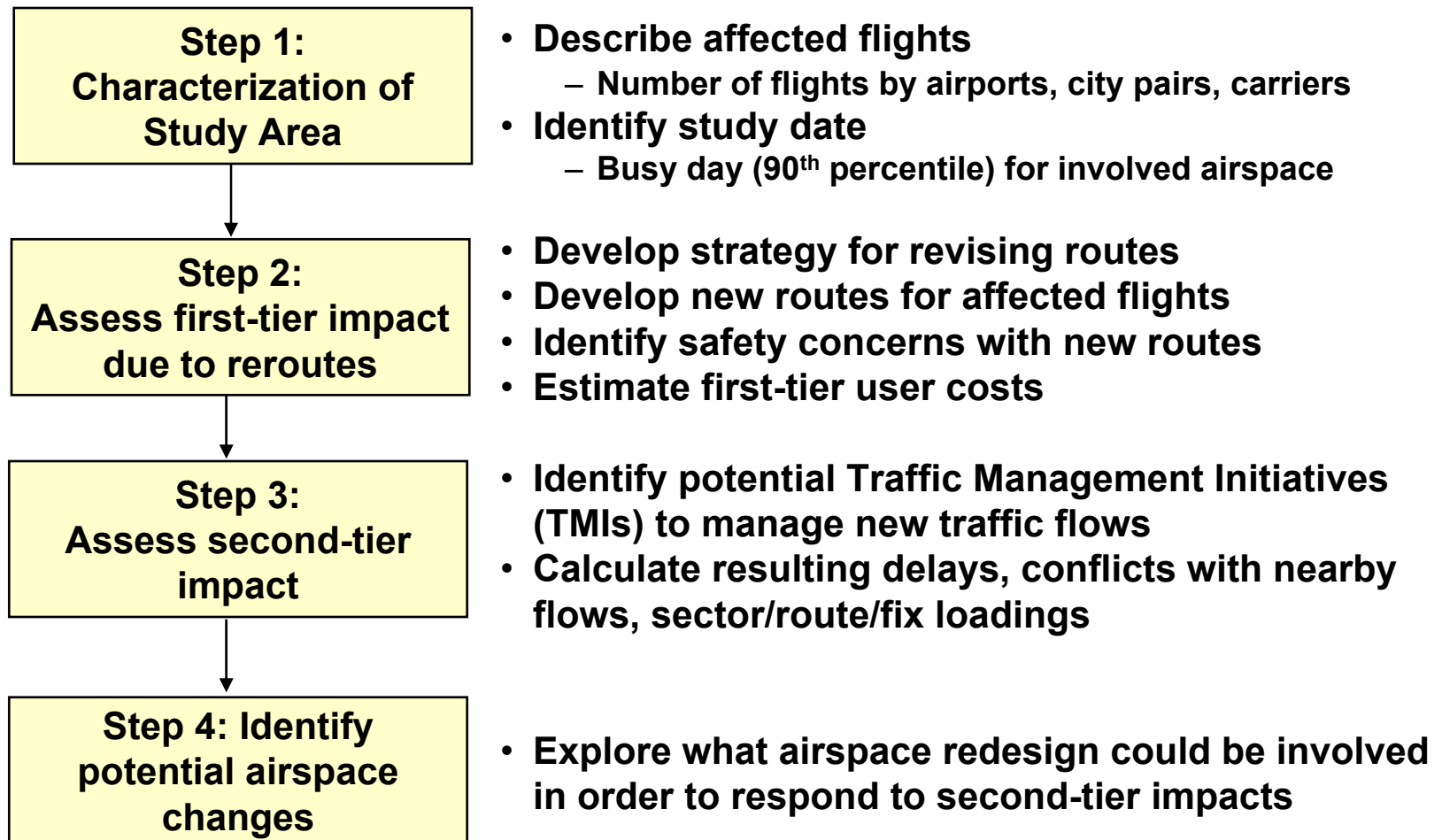
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- **Daytime (7:00 am to 7:00 pm) at or above 18,000 ft**
  - All flows
  - Only Las Vegas (LAS) arrivals and departures
  - Only North-South routes, mainly Phoenix (PHX) arrivals and departures
  - Only East-West overflights to/from Basin area airports\*

\* Los Angeles (LAX), Burbank (BUR), Santa Monica (SMO), Van Nuys (VNY), Ontario (ONT), Santa Barbara (SBA), Palm Springs (PSP), Carlsbad (CRQ), San Diego (SAN), Orange County (SNA), Long Beach (LGB)

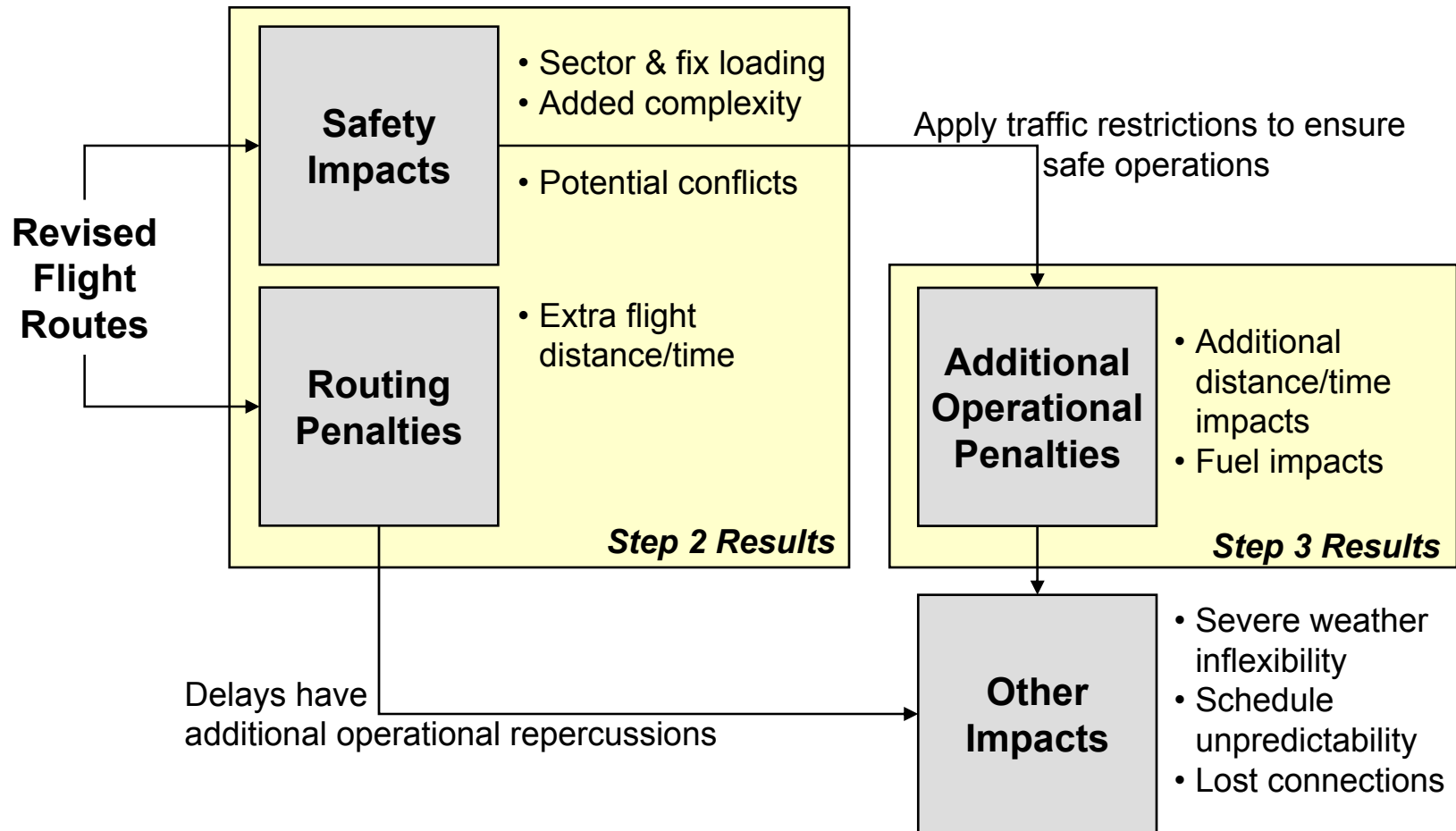


# Impact Assessment Process





# Overview of Indicators and Metrics





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## Step 1: Characterization of Traffic in Study Area

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# General Characterization of Affected Flights

- Based on 2005 historical ETMS data, almost 130,000 daytime flights at or above 18,000 ft would be affected per year

## Daytime Traffic

Traffic Flow	Annual Flight Counts
All	129,000
LAS arrivals	9,000
LAS departures	21,000
PHX arrivals	20,000
PHX departures	19,000
Basin arrivals	40,000
Basin departures	12,000
Other	8,000

## Nighttime Traffic

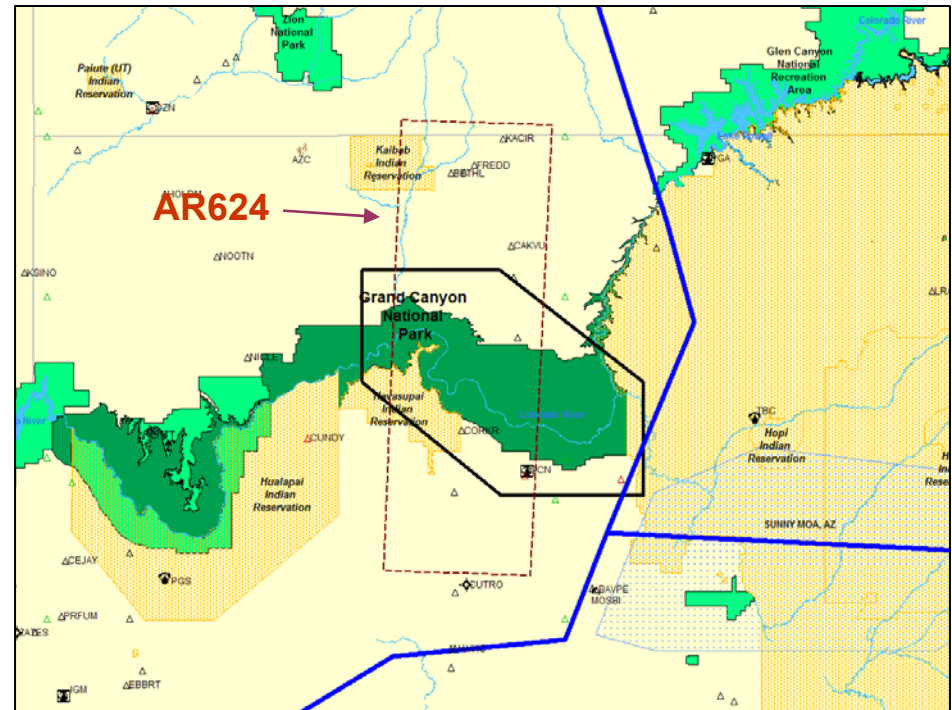
Traffic Flow	Annual Flight Counts
All	51,000
LAS arrivals	4,000
LAS departures	11,000
PHX arrivals	5,000
PHX departures	6,000
Basin arrivals	18,000
Basin departures	5,000
Other	2,000





# Military Operations

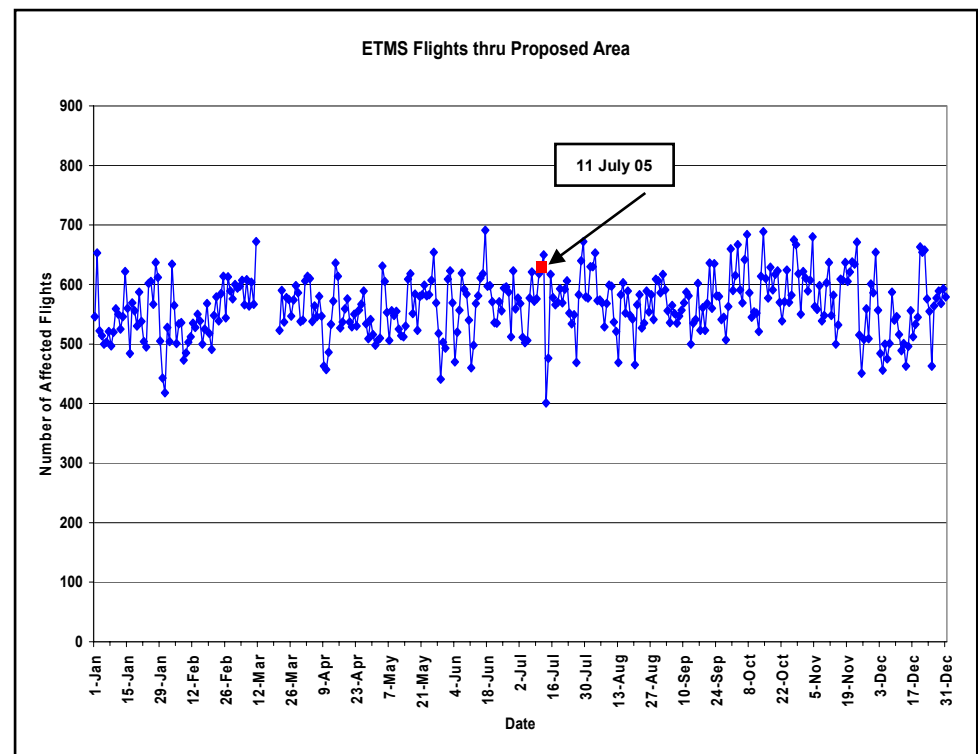
- Military aerial refueling route AR624 traverses the Grand Canyon area
- AR624 encompasses FL190-220 with occasional vertical limits expanded up to include FL290





# Study Day

- Offload radar data from 11 July 2005, representing a 90<sup>th</sup> percentile day; flights at or above 18,000 ft
- Number of flights within polygon
  - 476 daytime flights
  - 190 nighttime flights
- Traffic management logs reviewed to ensure no major TMIs were active





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## **Step 2: Revising Flight Routes, Safety Consequences and First-Tier User Impact**

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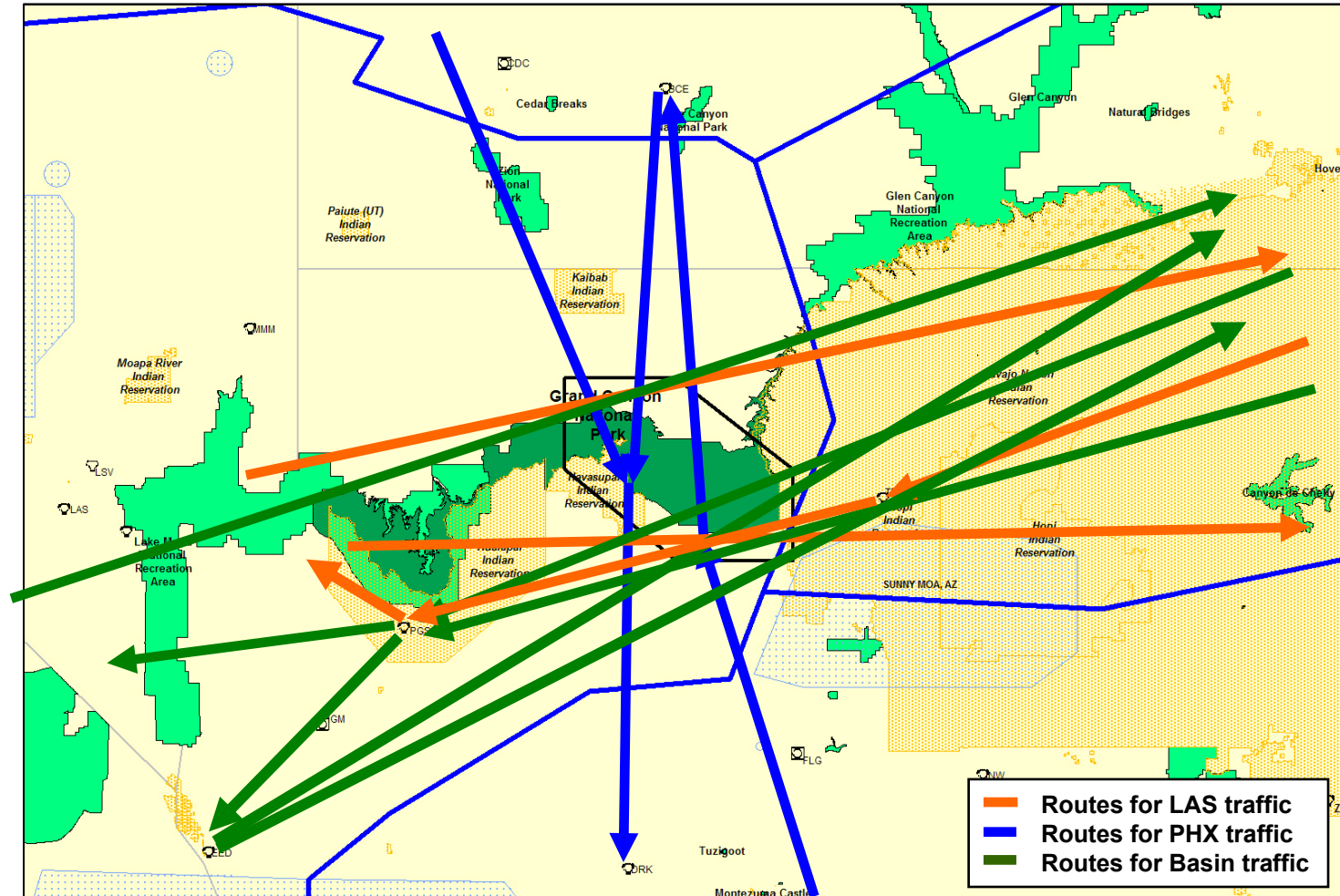
# Revised Flight Routes

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- The preliminary set of revised routes to avoid proposed polygon have been reviewed
- Revised routes designed
  - Based on MITRE CAASD operational expertise
  - To use existing navigation aids (NAVAIDs) and waypoints
  - To retain current arrival and departure fixes, if possible
    - Only a new transition for SILOW ONE terminal departure procedure for PHX added (49 flights)



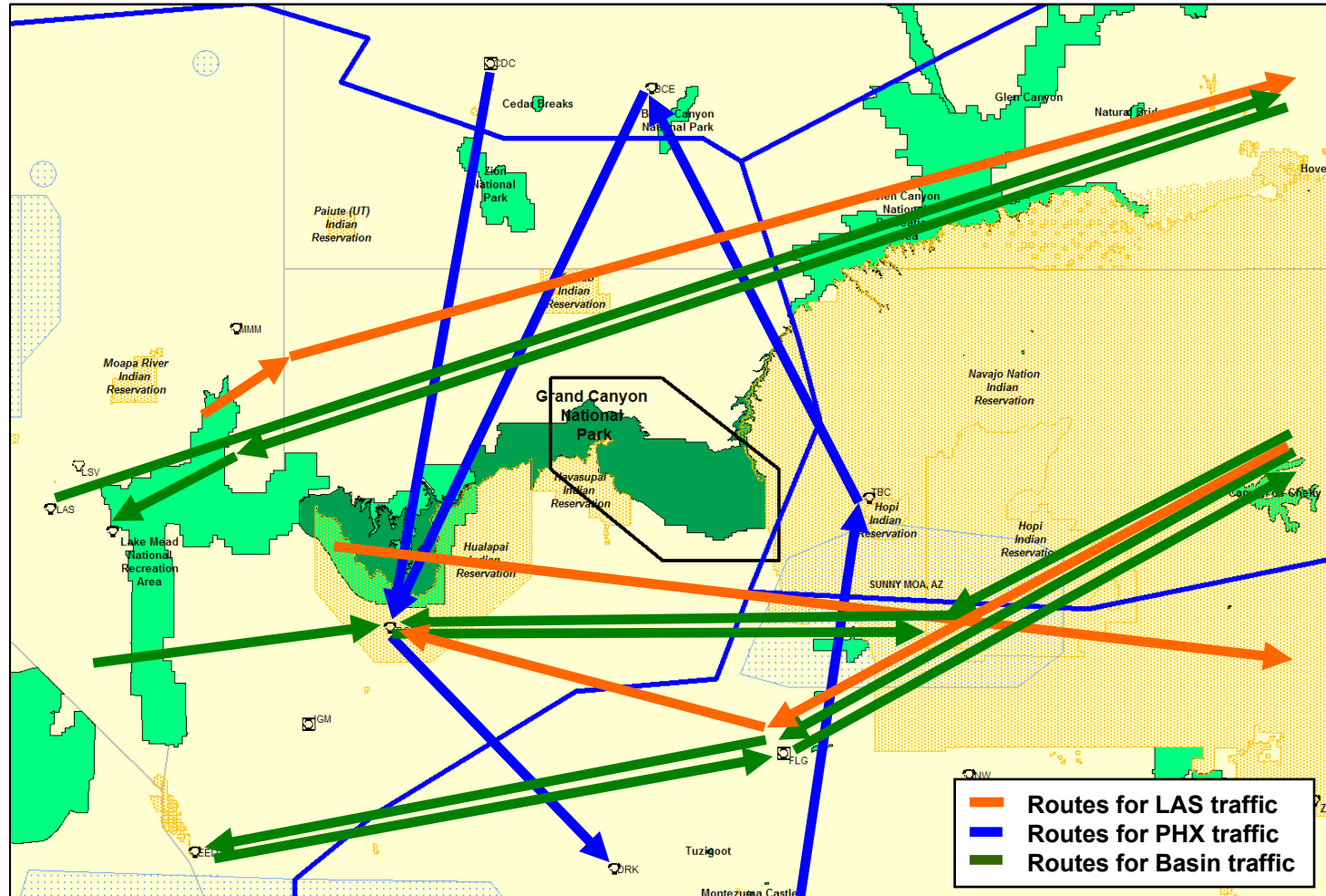
# Current Routes







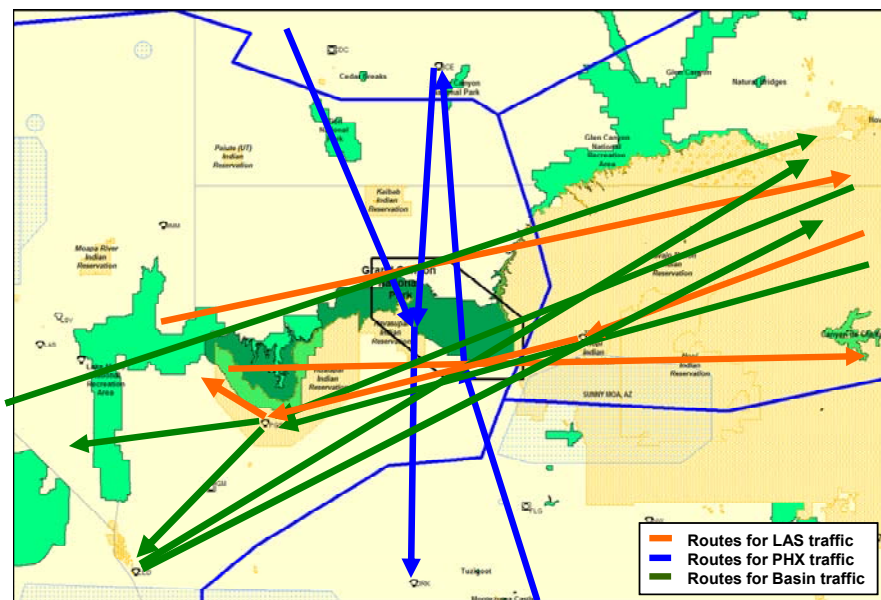
# Revised Routes



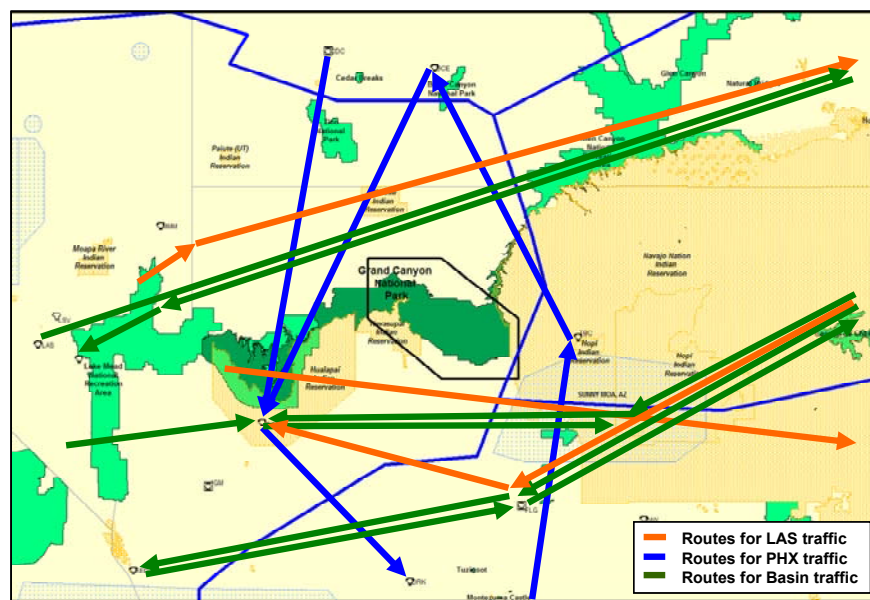


# Routing Difference

## Current Routing



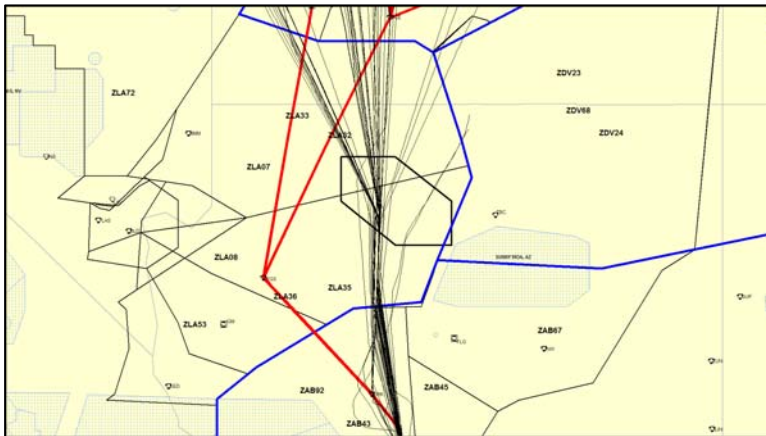
## Revised Routing



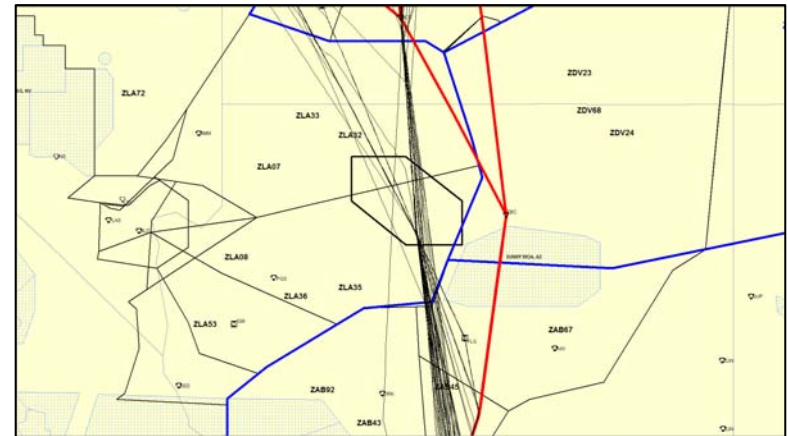


# Revised Routes – PHX traffic

Flights arriving at PHX



Flights departing from PHX

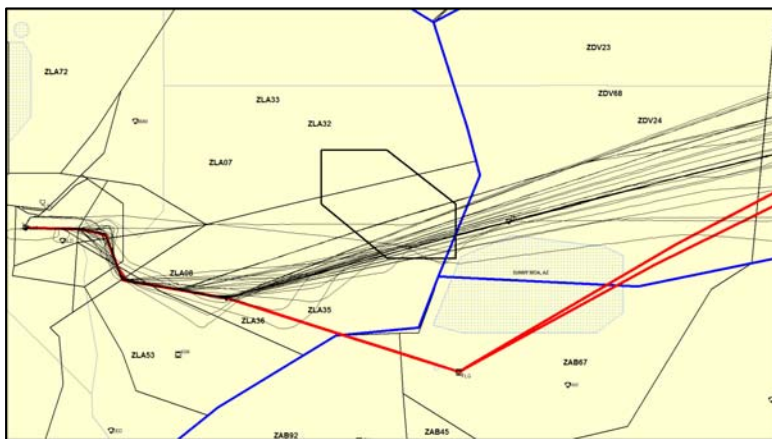




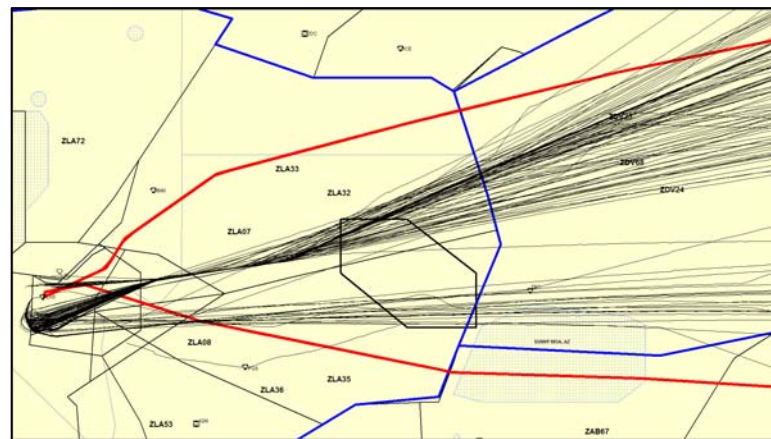


# LAS Traffic

Flights arriving at LAS



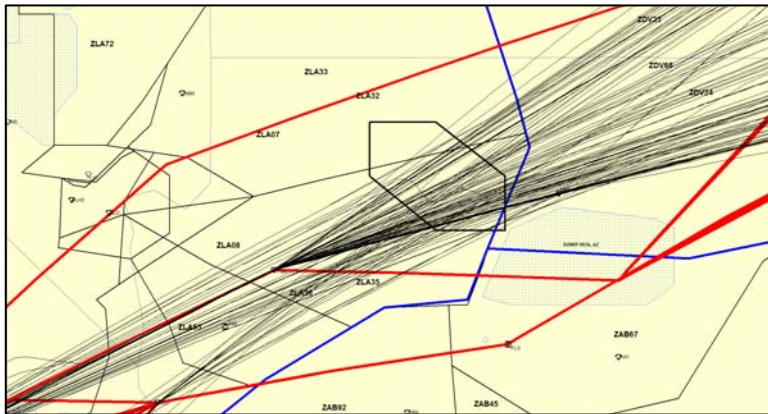
Flights departing from LAS



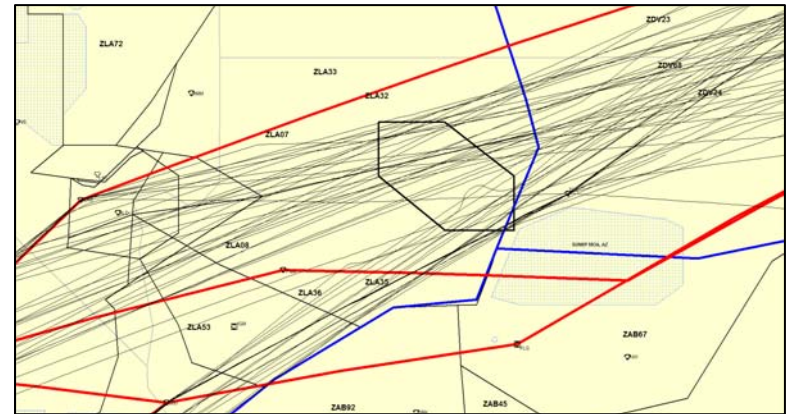


# Basin Traffic

**Flights arriving at Basin area airports**



**Flights departing from Basin area airports**





# Overview of Safety Impacts

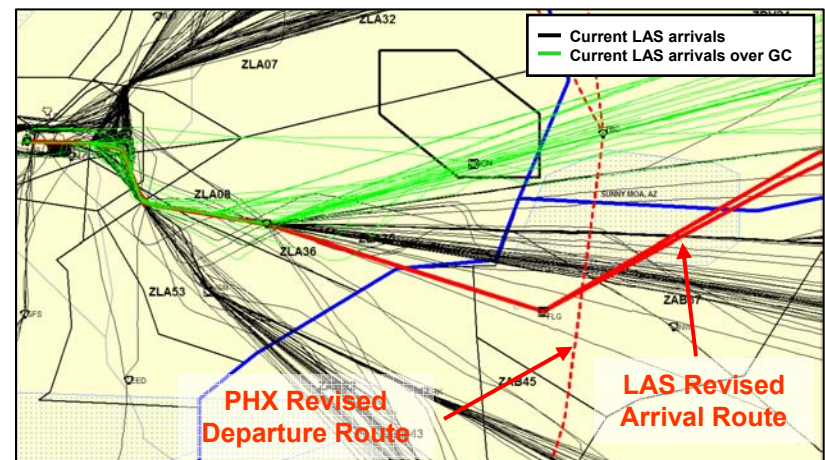
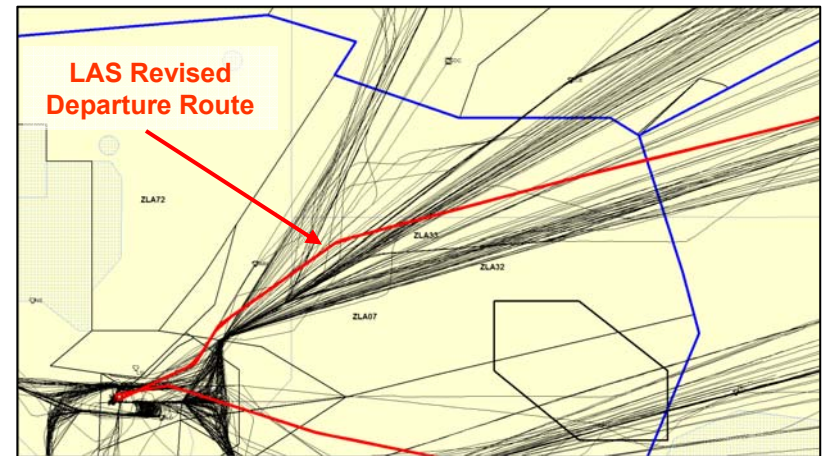
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- **Revising routes has several operational consequences**
  - **Moves flights from one sector to another**
    - **Increases the number of aircraft in sectors**
    - **Introduces new workload and increases sector responsibilities**
  - **Concentrates additional flights over specific fixes**
  - **Moves some flows closer to other flows**
  - **Creates new merge points in the airspace, adding to the complexity of the traffic flows**



# Safety Concerns with LAS Reroutes to Restrict Flights from Study Area

- Departures moved to OVETO, **closer** to LAS arrivals from the northeast
- LAS arrivals moved further south into Albuquerque ARTCC (ZAB) Sector 67 which would **increase sector count**
- ZAB 67 would be required to **merge and descend** the LAS traffic for Los Angeles ARTCC (ZLA) Sector 35
- The LAS arrivals would be a problem with the PHX departures climbing from SILOW to Tuba City (TBC), **mixing arrivals and departures**

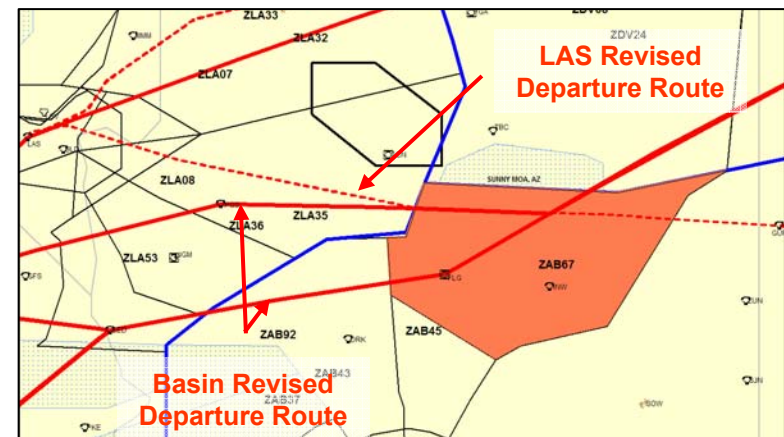
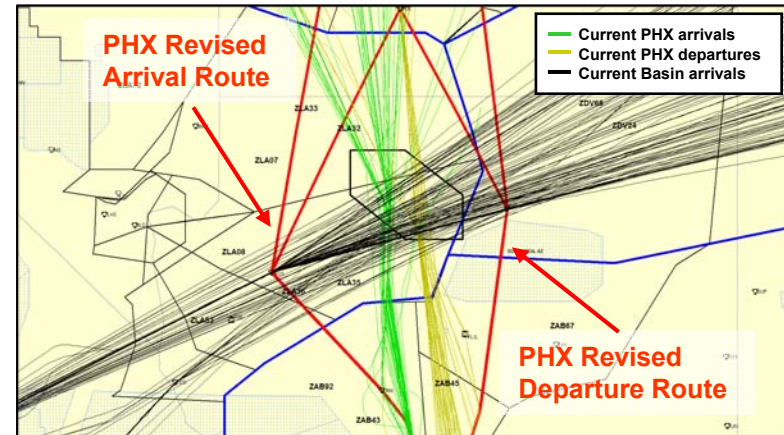






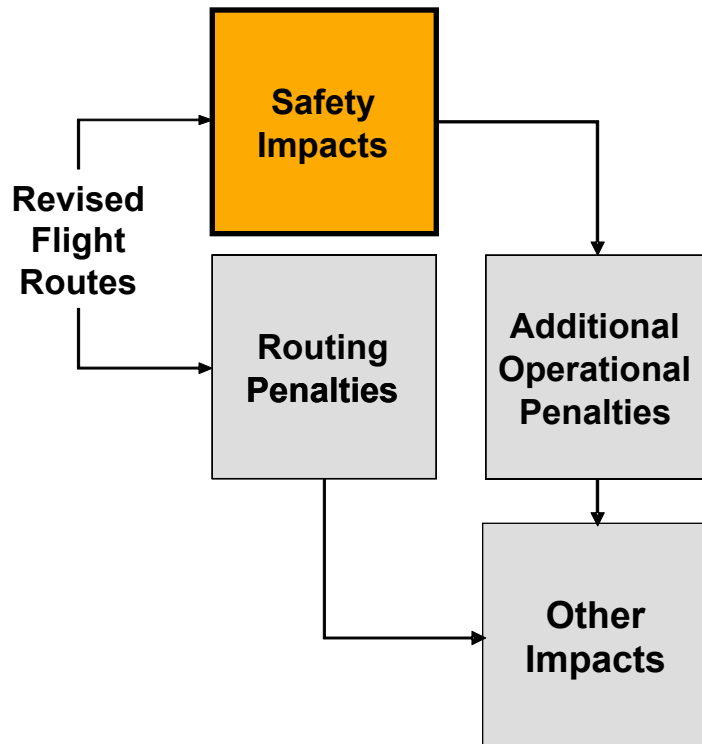
# Safety Concerns with PHX and Basin Revised Routes to Restrict Flights from Study Area

- PHX Routes
  - Arrivals move westward, **increasing number of aircraft over PGS**
    - PGS is currently used by LAX arrivals and departures
  - Departures move east over TBC
- Basin Routes
  - ZAB 67 would be required to **merge/cross** the ZLA Basin departures that fly over Needles (EED) to FLG J10 with the departures over PGS J72 to J10, and the LAS eastbound departures to Gallup (GUP) or J72 to J10





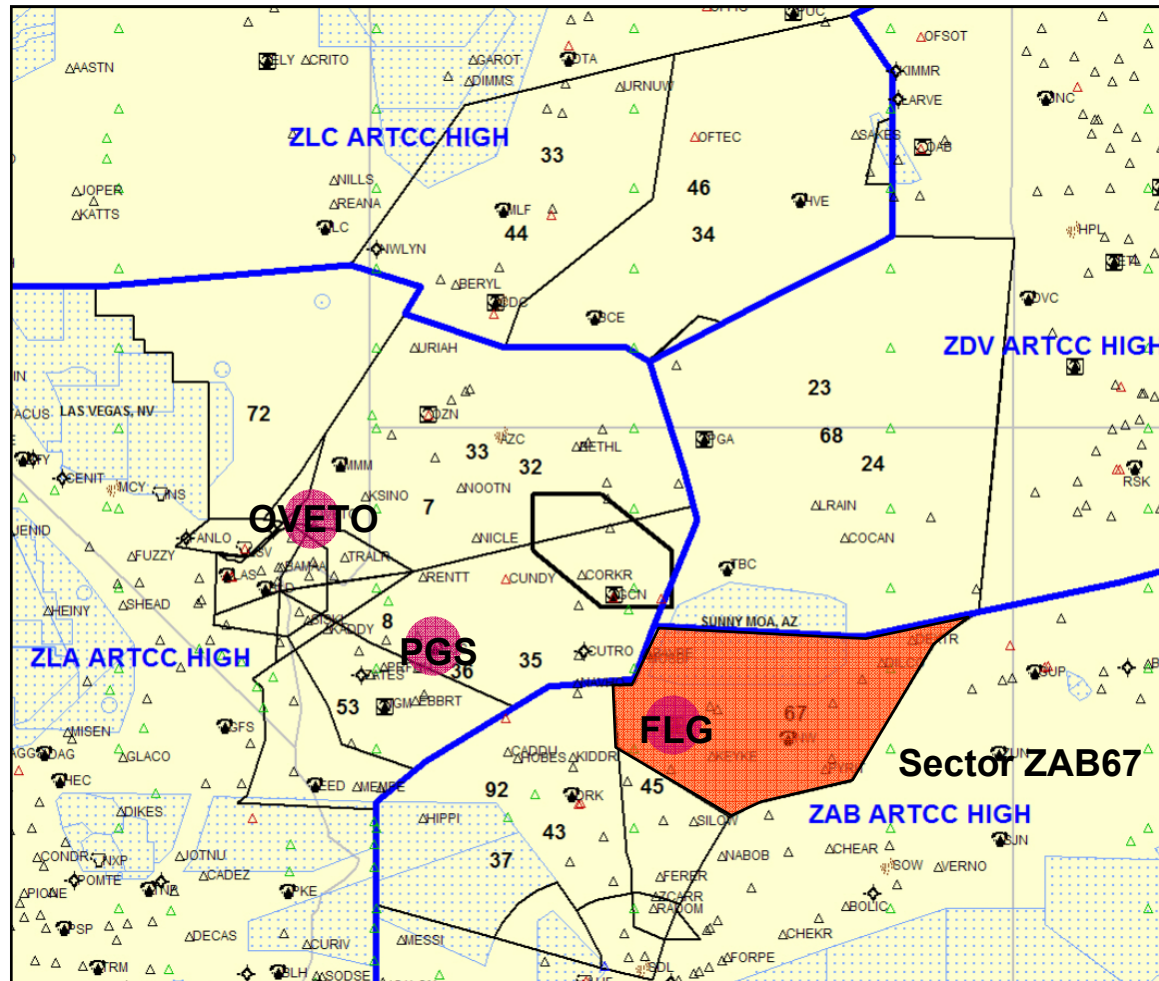
# Safety Impact Indicators



- **Sector loading: number of aircraft in a sector**
  - The number of aircraft in a sector is an indicator of complexity
- **Fix loading: number of aircraft that flow over a single point in the airspace**
  - An increase in fix loading is an indicator of added complexity and higher workload
- **Potential conflicts: number of aircraft that come within close proximity of each other**
  - The number of potential conflicts indicate the potential increased risk of collision



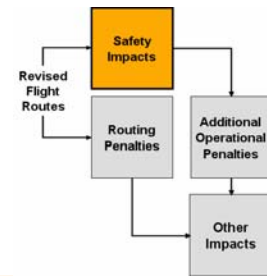
# Sectors and Fixes of Interest



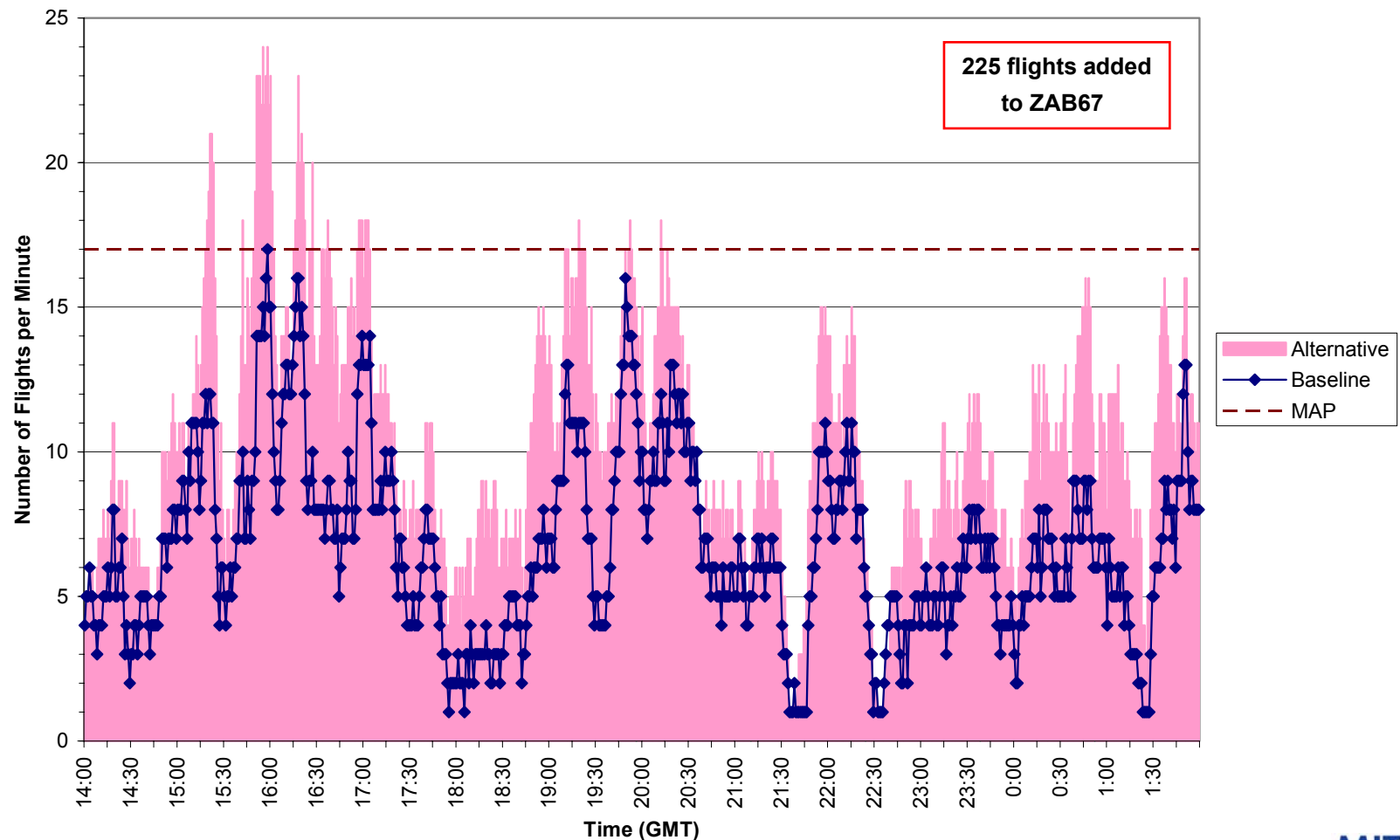


# Sector Loading Example

## Daytime All Traffic Scenario



ZAB67 - All Flows, daytime traffic

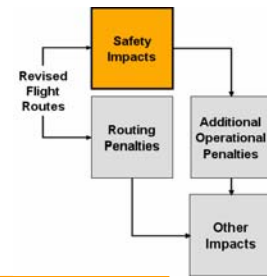




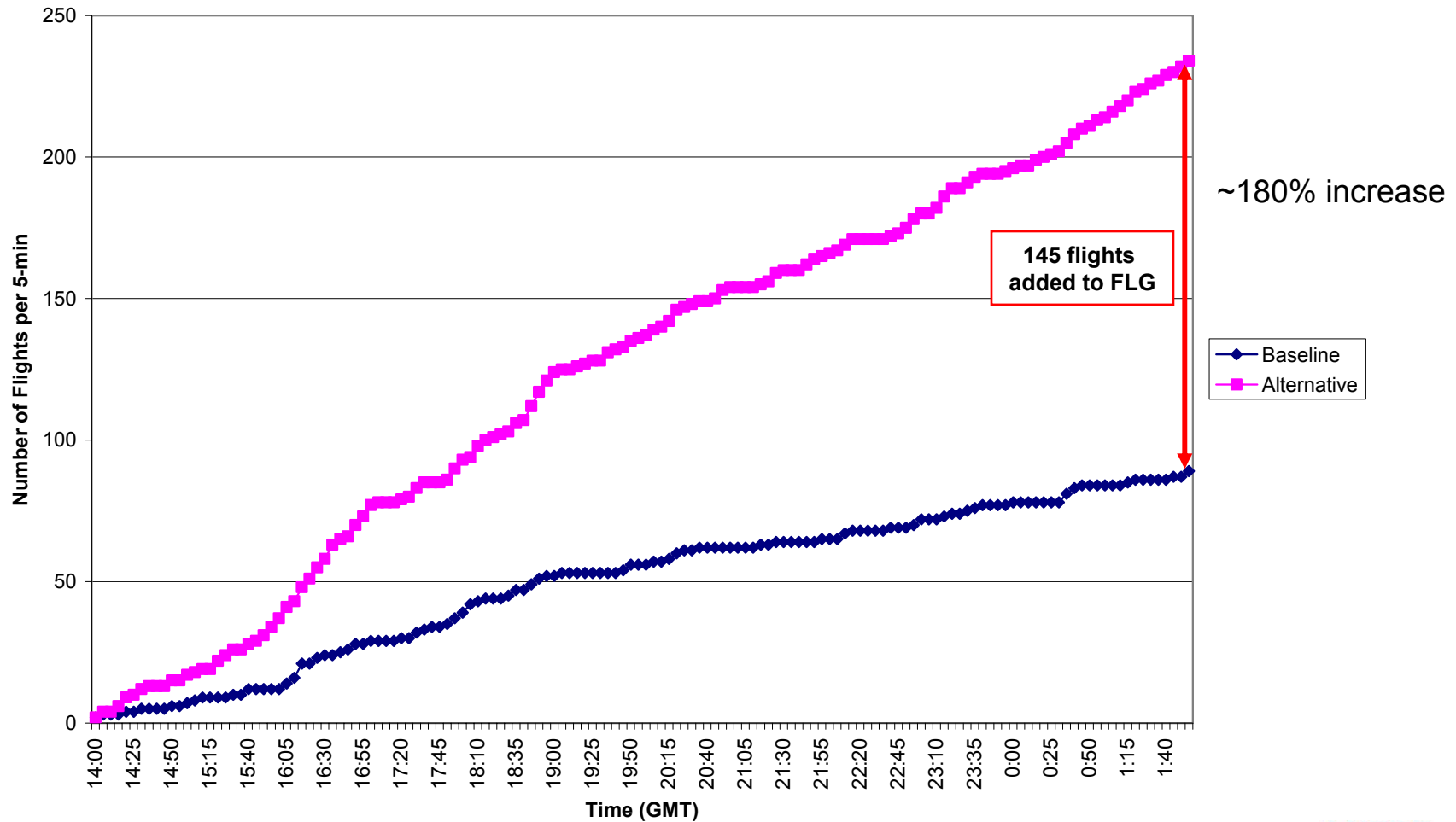


# Fix Loading Example

## Daytime All Traffic Scenario



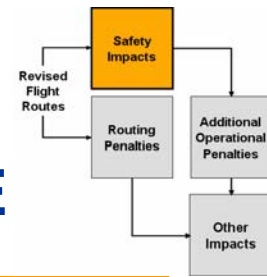
FLG - All flows



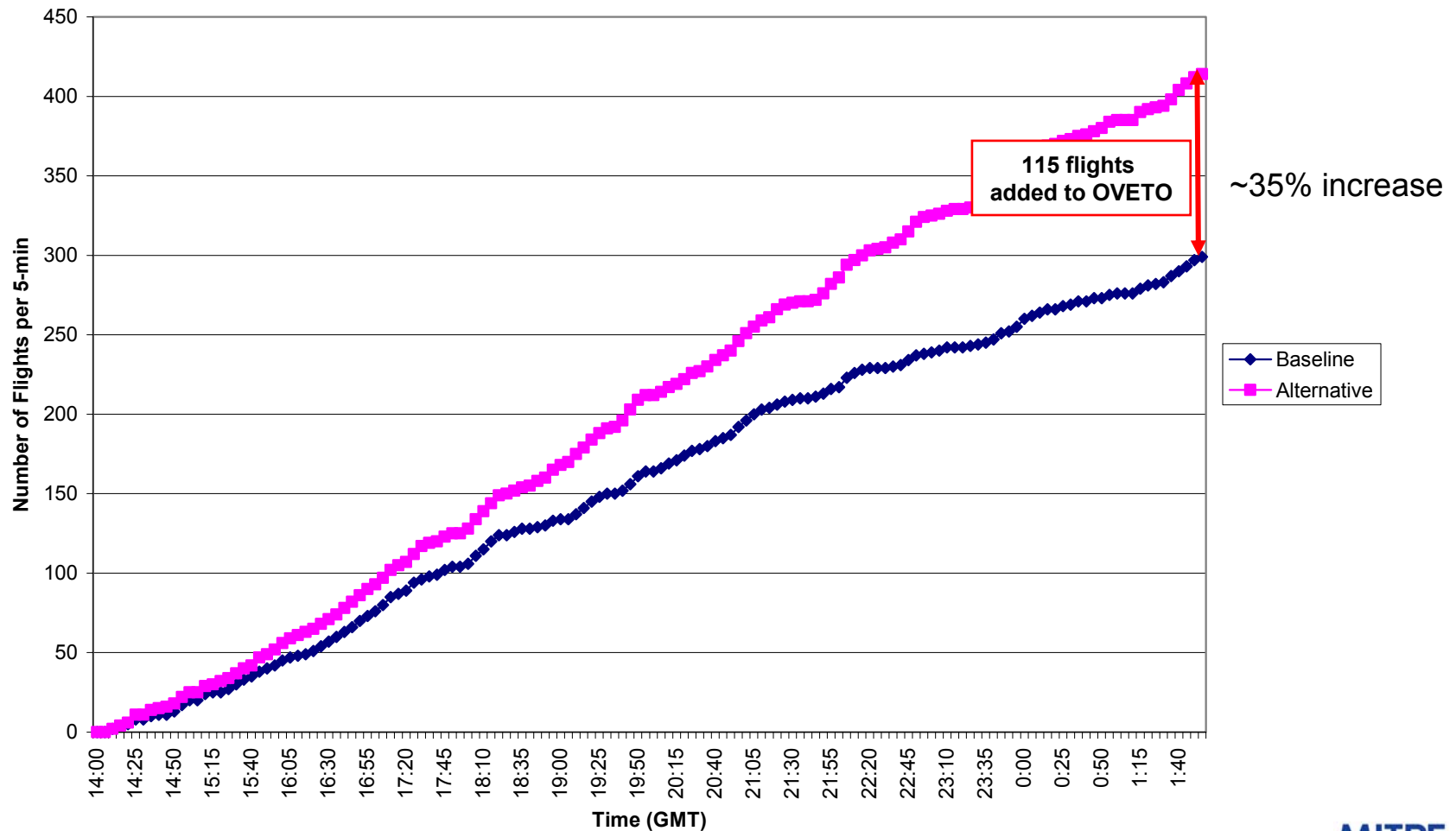


# Fix Loading Example

## Daytime LAS Scenario - Departures to NE



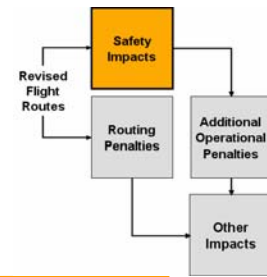
OVETO



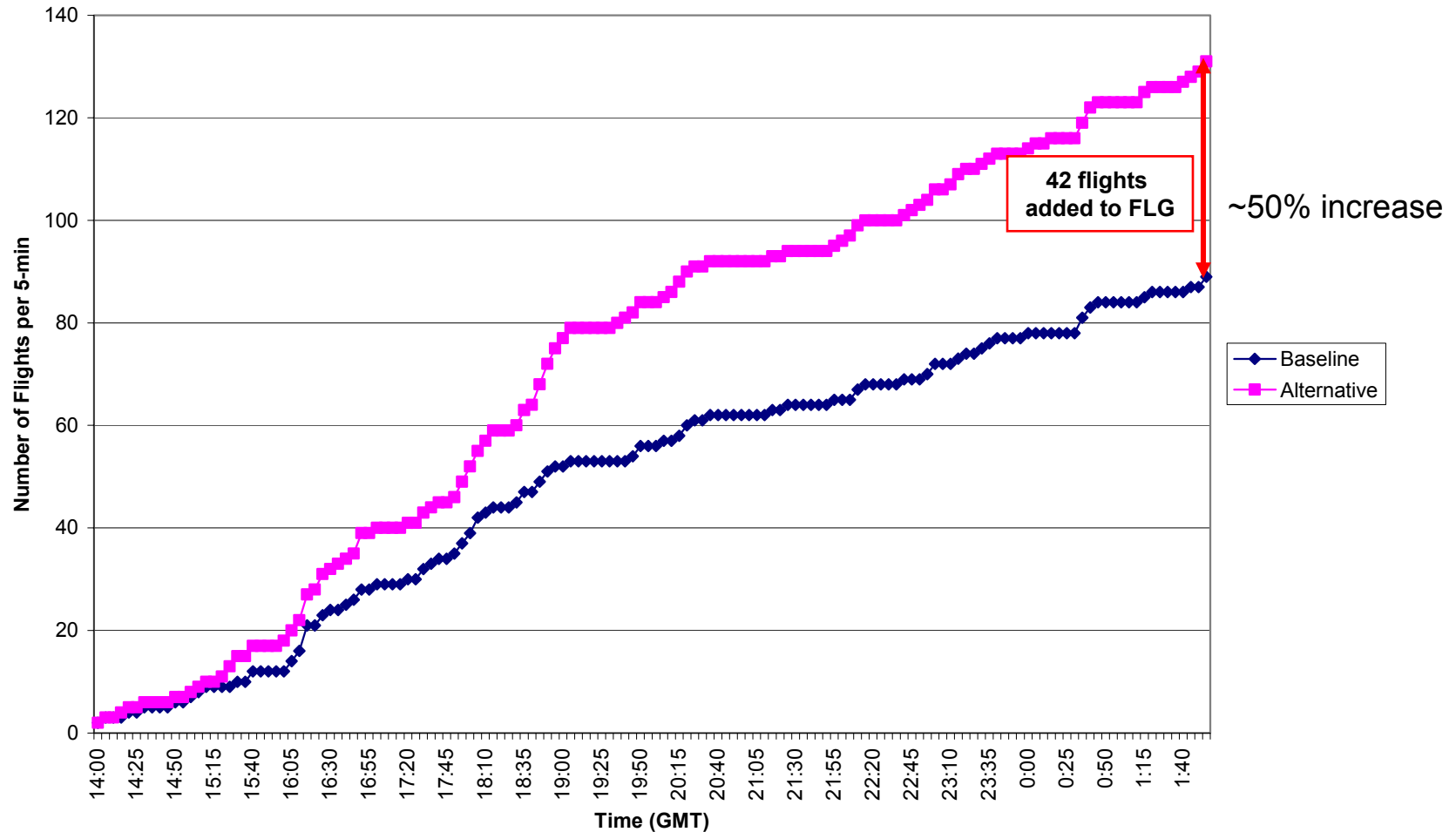


# Fix Loading Example

## Daytime LAS Scenario - Arrivals from SE



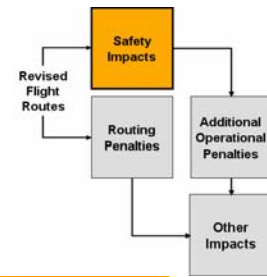
FLG - LAS flow only



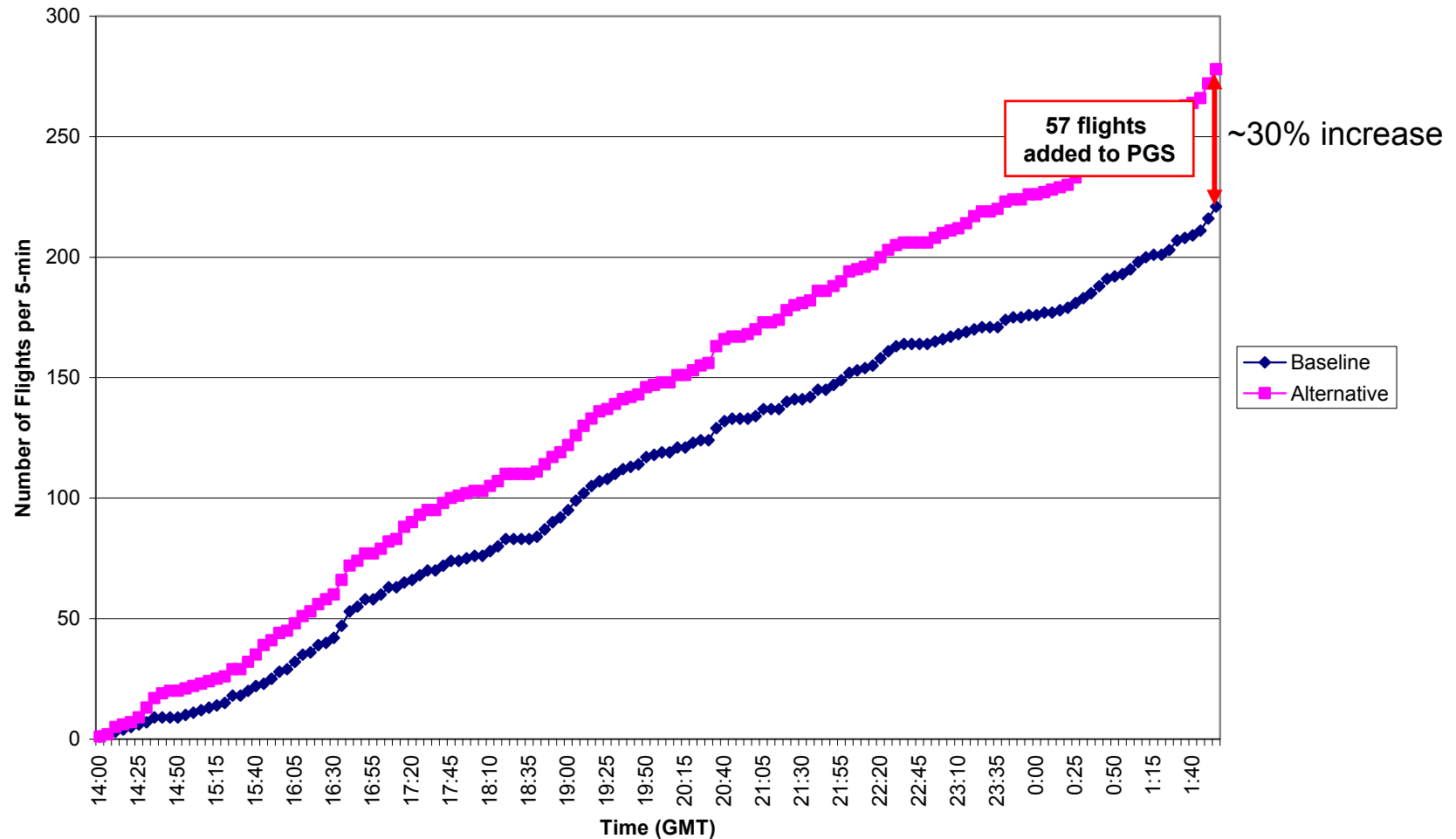


# Fix Loading Example

## Daytime PHX Scenario



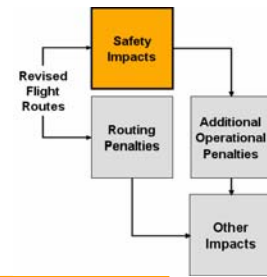
PGS - PHX flow



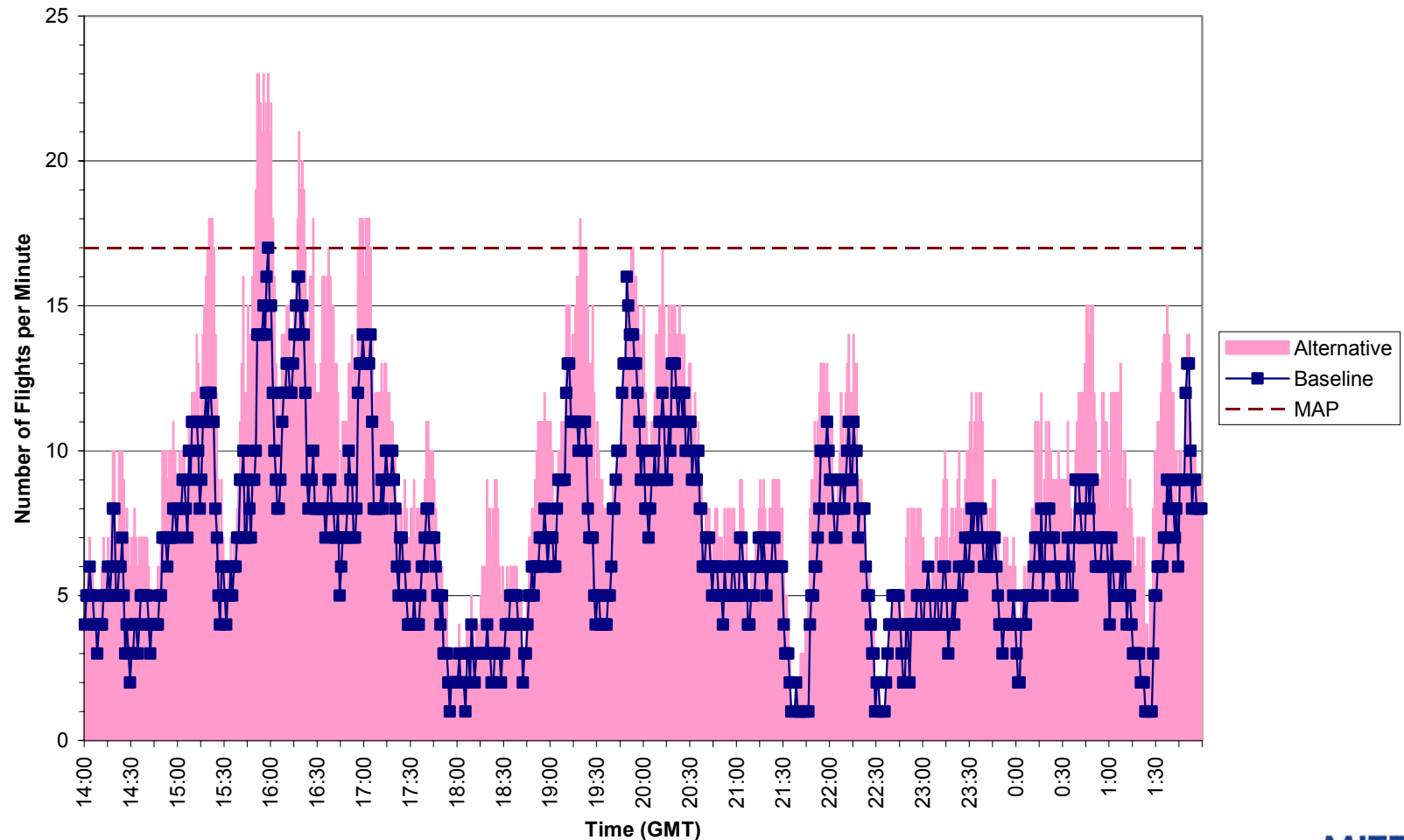


# Sector Loading Example

## Daytime Basin Traffic Scenario



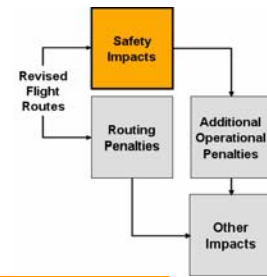
ZAB67 - Basin flow only, daytime traffic



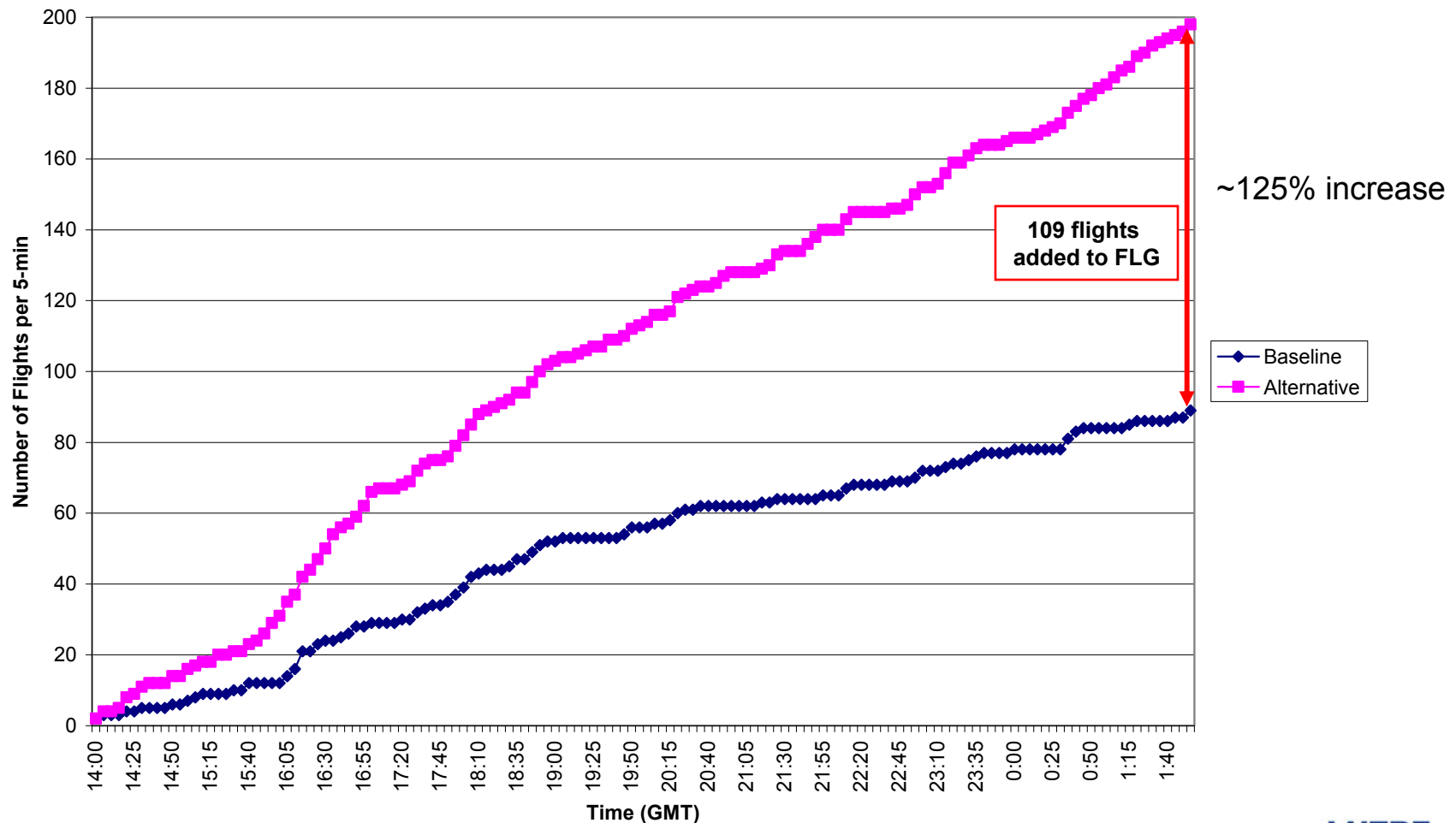


# Fix Loading Example

## Daytime Basin Traffic Scenario

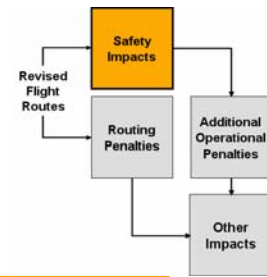


FLG - Basin Flow, daytime

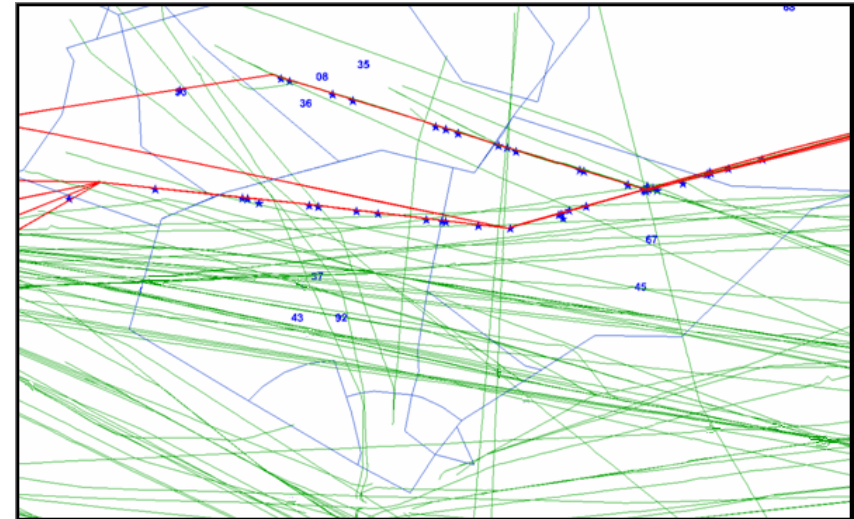




# Potential Conflicts

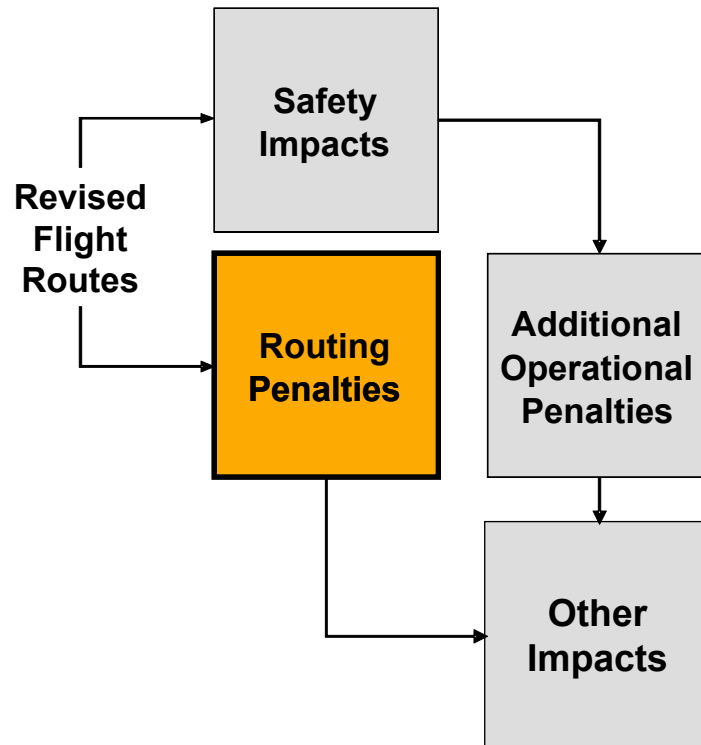


- Potential conflicts between existing traffic flows and aircraft using revised routes to avoid the Grand Canyon were examined
  - Potential conflicts are defined as two aircraft that are less than 5 nautical miles (nm) horizontally and 1,000 ft vertically of each other in en route airspace
  - Potential Conflicts identified using FAA's Sector Design and Analysis Tool (SDAT)
- Potential conflicts added due to revised routes (daytime traffic only)
  - PHX flow: 19 conflicts/day
  - LAS flow: 44 conflicts/day
  - Basin flow: 114 conflicts/day
  - All flows: 336 conflicts/day





# Overview of Routing Penalties

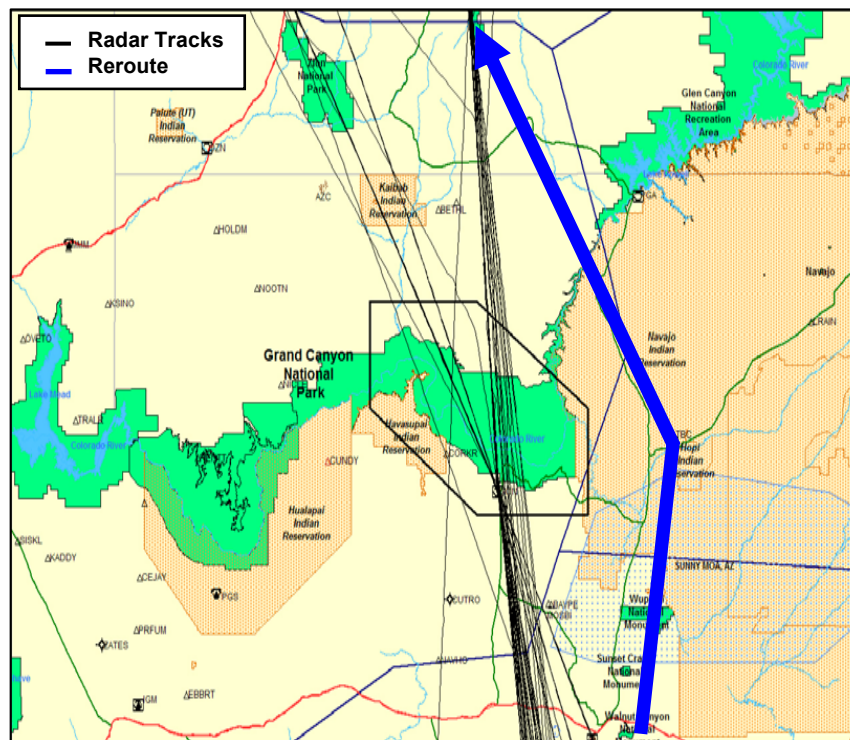


- **Extra distance flown is translated into extra flying time, based on type of aircraft and associated performance characteristics**



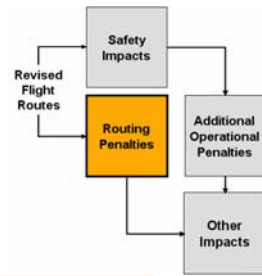


# Example of Revised Routes





# First-Tier Efficiency Impacts



- **Average distance added**
  - **LAS arrivals: 25 nm**
  - **LAS departures: 0.5 nm – 3 nm**
    - 0.5 nm (to northeast airports)
    - 3 nm (to southeast airports)
  - **PHX arrivals: 30 nm**
  - **PHX departures: 7 – 20 nm**
    - 7 nm (to SLC)
    - 20 nm (to northwest airports)
  - **Basin arrivals: 10 nm – 35 nm**
  - **Basin departures: 10 nm – 25 nm**



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## **Step 3: Assessment of Potential Traffic Management Initiatives**

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# Overview of Traffic Management Restrictions

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- **When airspace or other system resources are overloaded, TMIs are issued to ensure safe operations**
  - **Aircraft-to-aircraft restrictions: Spacing between aircraft is increased to ensure that controllers have enough time to address volume or complexity**
    - **Miles-in-Trail (MIT): increases spacing in flight**
    - **Ground delay: keep aircraft on ground until space is available**
  - **Flow-to-flow restrictions: flows of aircraft are separated from other flows**
    - **Capping: limits the altitude of a specified flow**



## Overview of TMs (*concluded*)

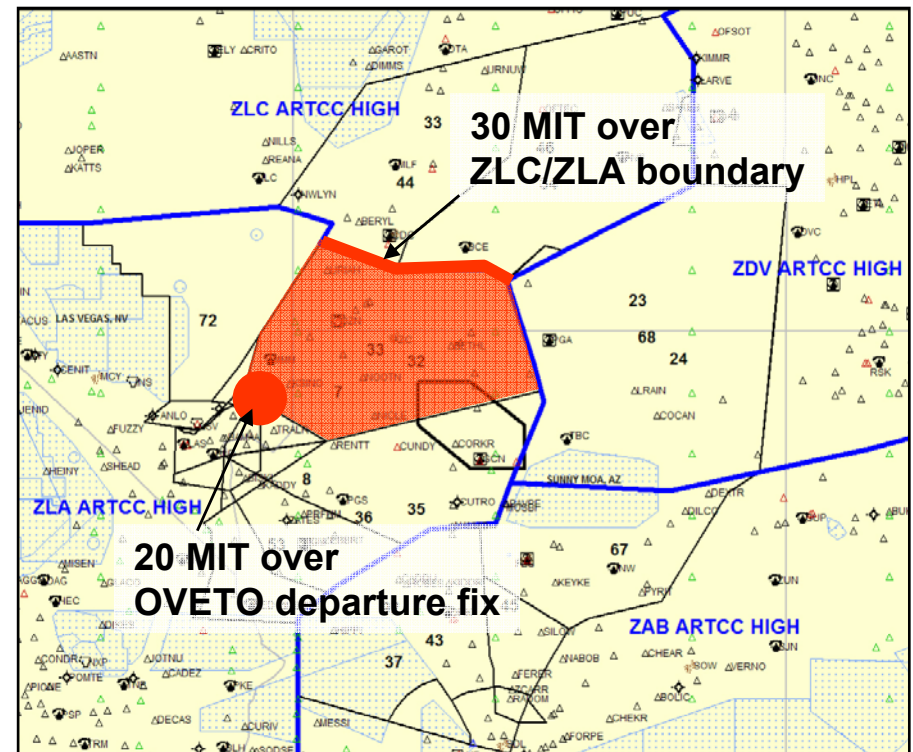
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- **Restrictions are resource dependent and were only applied to applicable flows**
- **Examined modeled sector volume and compared with thresholds that are currently used by the FAA's Traffic Management Units and the Air Traffic Control System Command Center**
- **Reviewed logs and playbooks to ascertain appropriate restrictions**
- **Completed peer review of proposed restrictions**



# Potential Traffic Management Initiatives

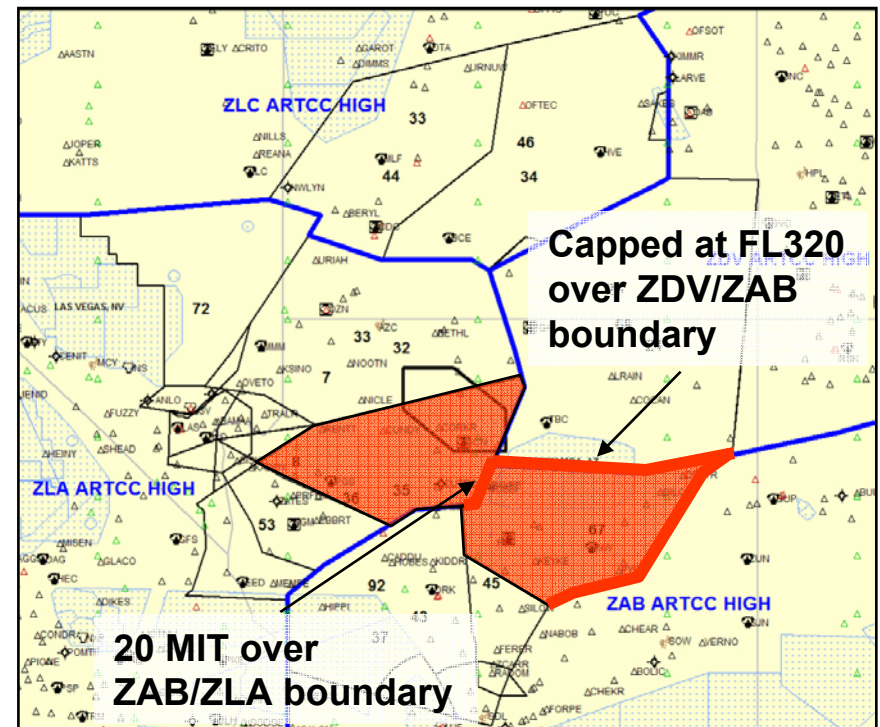
- **LAS arrivals from north/northeast**
  - MIT restrictions imposed to manage ZLA07 volume
  - ZLA07 works arrivals from and departures to north/northeast
- **LAS departures to north/northeast**
  - MIT restrictions (ground delays) imposed to manage ZLA07 volume
  - ZLA07 works arrivals from and departures to north/northeast





# Potential Traffic Management Initiatives (continued)

- **LAS arrivals from southeast**
  - MIT restrictions imposed to facilitate merging current arrivals from southeast with arrivals from east moved over RSK to FLG and alleviate ZLA08 workload
  - Capping imposed to separate descending traffic from level traffic to and from Basin area in ZAB67



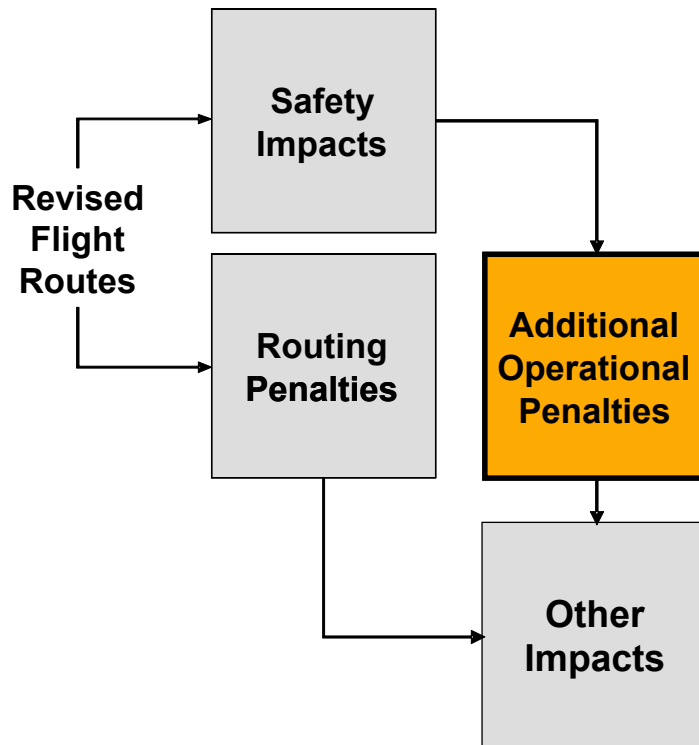








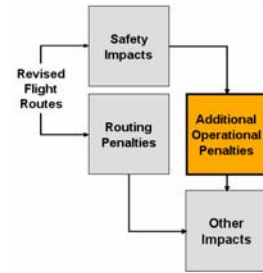
# Overview of Additional Operational Penalties



- **MIT restrictions were calculated for affected flights and translated into additional flying time**
- **Capping restrictions were translated into fuel penalties**



# Overview of TMI Impacts



- **MIT**

- LAS Arrivals from SE 166 delay min/day
- LAS Arrivals from N/NE 529 delay min/day
- Basin Departures over Needles and Peach Springs 37 delay min/day

- **MIT (ground delay)**

- LAS Departures to N/NE 136 delay min/day

- **Capping**

- LAS Arrivals from SE 1098 additional gal/day



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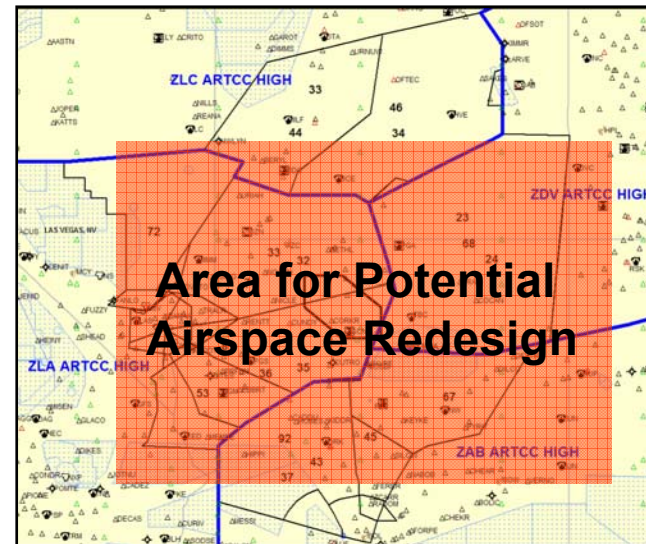
## Step 4: Potential Airspace System Changes

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# Potential Airspace Changes

- This analysis identified several major safety concerns and efficiency consequences
- Significant airspace redesign covering over 100,000 square miles involving at least six facilities would be required to address these issues
  - Revision of terminal arrival and departure procedures
  - New RNAV-based routes in en route/transition airspace
  - Significant realignment of sector boundaries
  - Realignment of facility boundaries
  - FAA predefined plans to handle Severe Weather events (playbook)





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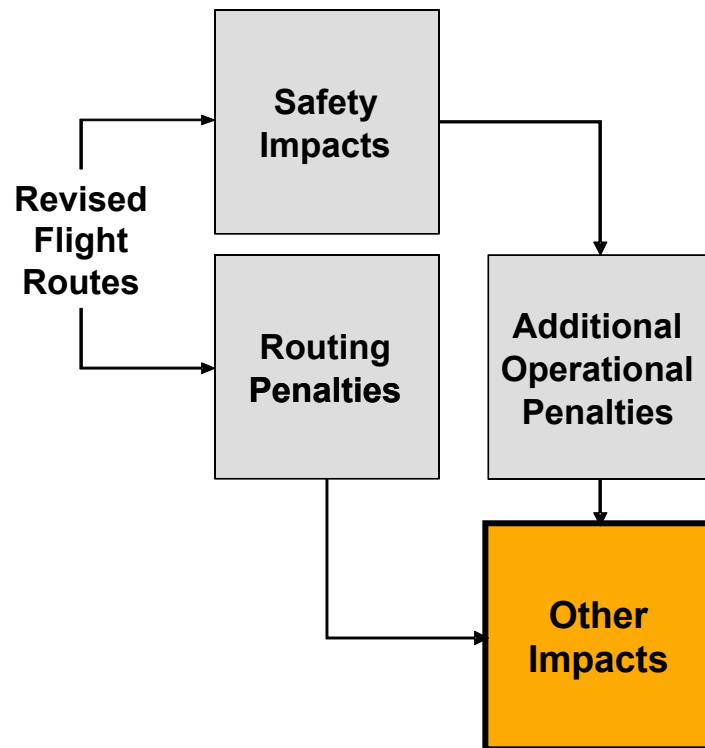
## Additional User Considerations

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# Factors Impacting User Costs

**Impacts to the airspace users is not limited to the direct operational penalties of time and distance**



## Examined:

- Added complexity during severe weather from newly routed Grand Canyon traffic over frequently used fixes
- Increased unpredictability of enroute performance as a result of added complexity
- Lost connection opportunities at arrival airports from later arrival times

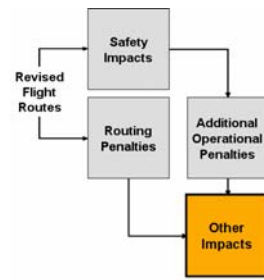
## Others (Not Examined):

- Airline fleet utilization and productivity
- Missed passenger connections from delays (if schedules are not modified)
- Changes in ground delay

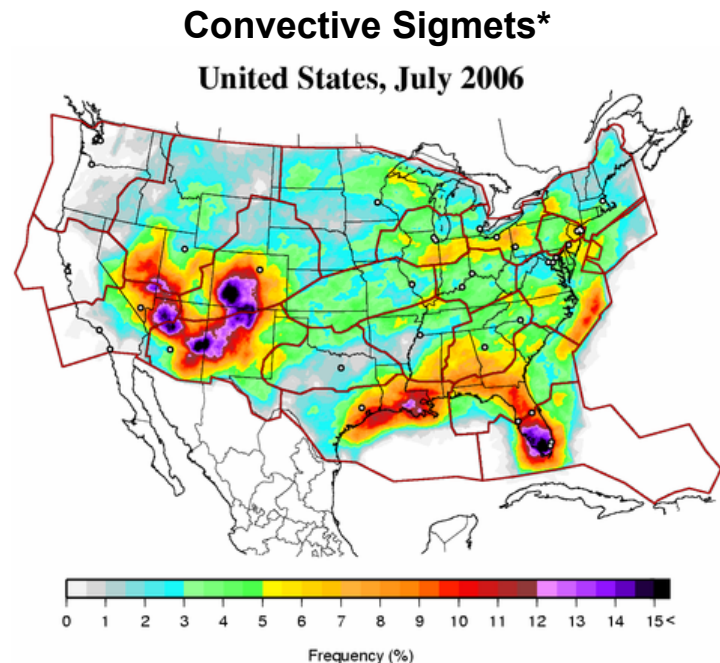




# Additional Complexity During Severe Weather



- During Severe Weather events, routes typically used by flights may not be available
- FAA will respond by coordinating with appropriate Air Traffic Control facilities and users to develop a plan in which aircraft can avoid weather
- Restricting flights from the Grand Canyon will limit options available to the FAA during Severe Weather
- Impact could be significant during marginal weather conditions, which occur with relative frequency in this region



\* Source: [www.ncdc.noaa.gov](http://www.ncdc.noaa.gov). "Sigmet" = significant meteorological Information.

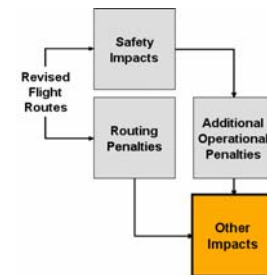
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# Added Complexity from Revised Routes



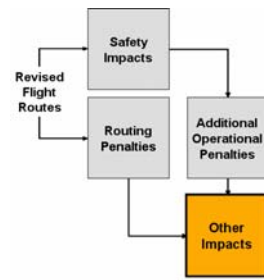
- **FAA has developed reroute advisories, defined in playbooks, used during Severe Weather events**
- **Revised routings for LAS, PHX, and Basin area traffic share some waypoints/NAVAIDS that define these reroute advisories**
  - **21% of all reroute advisories in 2006 used at least one of the fixes planned for use in Grand Canyon revised routes**
- **Revised routes could add congestion to key points in the airspace and adversely impact the National Airspace System's ability to respond to Severe Weather**
- **The operational impact would depend on**
  - **Degree of added complexity**
  - **Current fix loading**

**Fixes Planned for Grand Canyon Revised Routes and Measures of Utilization**

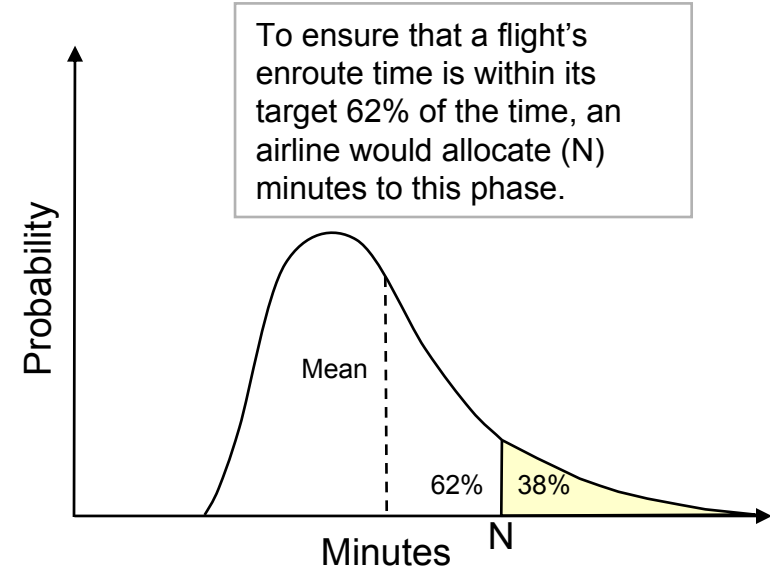
NAVAIDS/ Waypoints Involved	Instances in Current Playbooks	Reroute Advisories in 2006
BCE	33	109
COWBY	0	0
DAG	2	30
DVC	26	47
EED	14	85
FLG	2	0
GUP	19	65
HEC	26	37
OVETO	0	0
PGS	41	237
RSK	24	109
TBC	3	9
Total	190	728



# Increased Unpredictability

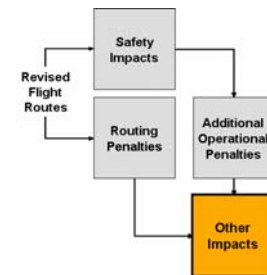


- Increased use of TMIs due to restricting flights over the Grand Canyon could increase variability in aircraft flight times
- Variability creates operational uncertainty for airlines
- Airline response strategies involve trade-offs
  - “Pad” schedules: maintain desired on time performance. May impact connecting passenger itineraries, decrease fleet productivity
  - Do not pad schedules: market shorter flights to the public, curb labor (crew) costs. May compromise on-time performance and bank integrity
- Impact depends on increase in flight time variability, and could be much greater than increase in average times





# Increased Unpredictability (concluded)



- Sensitivity analysis suggests a wide range in the schedule increase required to accommodate greater unpredictability
- Lowest impact corresponds to high time under “normal” operations, and low increases in uncertainty

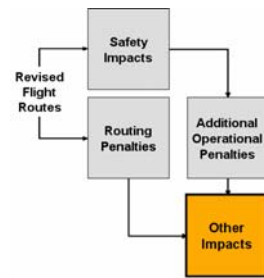
Required Increase in Scheduled Block Time To Maintain Baseline On-Time Performance  
(Assumption)

Time under "Normal" Operations	Increase in StDev during Irregular Ops (minutes)										
	0	4	8	12	16	20	24	28	32	36	40
50%	2.0	2.6	3.1	3.7	4.3	4.9	5.5	6.2	6.8	7.4	8.0
55%	2.0	2.5	3.0	3.5	4.1	4.6	5.2	5.7	6.2	6.8	7.3
60%	2.0	2.4	2.9	3.3	3.8	4.3	4.7	5.2	5.7	6.2	6.7
65%	2.0	2.3	2.7	3.1	3.5	3.9	4.3	4.7	5.2	5.6	6.0
70%	2.0	2.3	2.6	2.9	3.2	3.6	3.9	4.3	4.6	5.0	5.3
75%	2.0	2.2	2.4	2.7	3.0	3.2	3.5	3.8	4.0	4.3	4.6
80%	2.0	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	3.9
85%	2.0	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.1	3.2
90%	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.6
95%	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1
100%	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

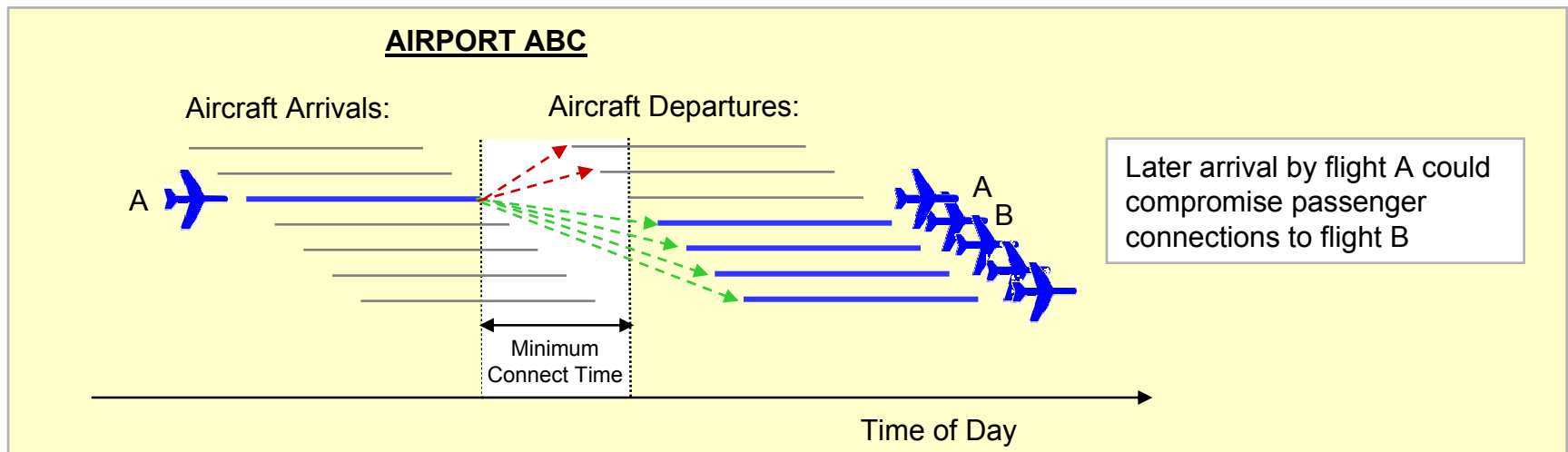
(most feasible range)



# Lost Connection Opportunities



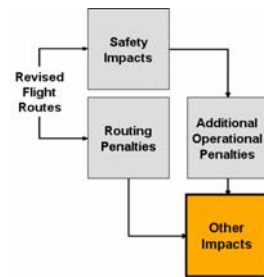
- **Description: Increased schedules could result in fewer “bookable” connecting passenger itineraries at arrival airport**
  - **All else equal\***, later arrival time for affected flights could violate passenger minimum connect times on existing itineraries
  - **These exact itineraries would not be sold**



\* While this assumption is not realistic, the analysis indicates the extent to which carriers would have to make operational (and marketing) trade-offs to mitigate the most adverse effects.



# Lost Connection Opportunities (continued)



Carrier	Arrival Airport											
	LAX		PHX		LAS		SLC		DEN		ORD	
	Avg Time Increase	Flights	Avg Time Increase	Flights	Avg Time Increase	Flights	Avg Time Increase	Flights	Avg Time Increase	Flights	Avg Time Increase	Flights
ELY	5.32	1							2.35	7		
FFT	<b>4.74</b>	<b>5</b>										
KLM	3.77	1										
BAW	3.75	3										
DLH	3.64	3										
UAL	<b>2.40</b>	<b>20</b>			2.98	2			<b>2.54</b>	<b>14</b>	<b>0.25</b>	<b>10</b>
AAL	<b>2.19</b>	<b>24</b>			5.03	1					0.05	1
MEP	1.98	2										
ACA	1.87	3										
AMT	1.60	1			2.83	1						
COA	1.46	8			2.93	1						
SKW	1.40	1	4.60	4			<b>1.50</b>	<b>11</b>				
NWA	1.37	5										
DAL	1.31	5			2.86	3	0.93	1				
SWA	1.25	10	4.31	8	<b>2.95</b>	<b>8</b>	0.97	5				
USA	0.85	2			3.37	4						
ASA	0.42	1	3.89	6								
AWE			<b>4.46</b>	<b>19</b>	3.49	3	0.93	3	0.12	3	0.13	2
ASH			5.24	9	3.98	1	0.93	3				
JBU					5.34	3						
CAA			4.38	2			1.34	4				
FDX					4.80	1						
CTA							3.73	1				
IDE					2.93	1						
TRS					2.88	1						
FWK					2.83	1						
CAR							2.48	1				
OPT			1.02	1								
All	2.19	95	4.44	49	3.43	31	1.36	29	2.18	24	0.21	13
% of Total GC Time Increase	22.8%		11.8%		7.4%		7.0%		5.8%		3.1%	

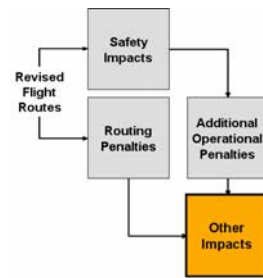
- Looked at arrival airports with the greatest enroute time increases due to Grand Canyon revised routes\*
- These airports comprise almost 60% of carrier time increases

\* Excluding any airline response to possible increased variability, as described previously.





# Lost Connection Opportunities (concluded)



- Some “lost” connection opportunities from later arrivals due to Grand Canyon revised routes
  - Applying flight-specific time increases to scheduled arrival time at destination airport
  - These reflect potentially unviable itineraries, ignoring market demand
  - Assumed 30 minute minimum passenger connect time, 3 hour maximum layover

Arrival Airport	Carrier	Possible Connections		Change
		Baseline	With GC Reroutes	
LAX	SWA	2,205	2,198	-7
	UAL	1,543	1,540	-3
	DAL	222	221	-1
	MEP	3	2	-1
PHX	AWE	7,483	7,471	-12
	ASH	2,871	2,863	-8
	SWA	5,798	5,791	-7
	ASA	8	7	-1
LAS	SWA	6,648	6,636	-12
SLC	SKW	11,393	11,386	-7
	ASH	9	7	-2
DEN	UAL	10,133	10,121	-12
	FFT	2,490	2,485	-5
ORD	UAL	16,501	16,495	-6



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## Valuation of Efficiency Impacts

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# Executive Summary of User Costs

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- **Value of the previous operational impacts has been estimated**
  - **First Tier Costs: Aircraft Direct Operating Costs (ADOC) associated with initial reroutes**
  - **Second Tier Costs: ADOC and fuel costs associated with TMIs applied after reroutes**
- **Conservative estimated user cost of ~\$30M\* annually if all traffic above 18,000 ft is restricted from the polygon of airspace above the heart of the Grand Canyon**
  - **Additional user costs factors could triple annual estimates**

\* Annual costs will vary based on fuels costs and assumed traffic scenario.



# Aircraft Direct Operating Costs (ADOC)\*

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- **Standard method to compute costs**
  - Increases directly with flight time
  - Includes Crew, Fuel, and Maintenance expenses
- **Calculated average costs per minute that reflect the fleet mix of three scenarios:**
  - LAS arrivals and departures only
  - PHX arrivals and departures only
  - Basin area arrivals and departures
- **Treated Carrier and General Aviation (GA) flights separately to account for different cost structures**
- **Average ADOCs for each scenario are weighted by fleet mix and operator (carrier and GA)**

\*Source of ADOCs: *Economic Values for FAA Investment and Regulatory Decisions, A Guide* (2004)



## ADOC (concluded)

- Derived estimate of airborne ADOC from block-to-block average\*
- 2002 FAA values adjusted to reflect current dollars using annual inflation rates\*\*
- Fuel component adjusted from 2002 levels to account for recent trend
  - Applied the following ratio to the fuel cost per minute:  
(Projected Jet Fuel Price per gal) / (2002 Jet Fuel price per gal)\*\*\*
  - Projected Jet Fuel Price used: \$2.00/gallon

Airborne ADOC	Cost per minute
LAS arrivals and departures Only	\$ 59.13
PHX arrivals and departures Only	\$ 49.38
Basin arrivals and departures Only	\$ 66.58

\*An average air to ground fuel burn ratio of 6 to 1 was applied.

\*\*Source of annual inflation data: Bureau of Labor Statistics.

\*\*\*Source of Jet fuel data: ATA; based on average of three U.S. sport market prices.



# User Cost Related to Revised Routes

- User costs due to extra time flown only, for 18,000 ft and above
  - Daytime flights only

Scenario	Number of Affected Flights	Extra Time Flown (min)	Weighted ADOC (\$/min)	Daily Cost (\$)	Estimated Annual Cost (\$)
All traffic	476	1005.2	--	60,495	16,400,000
LAS traffic	136	140.5	59.13	8,309	2,300,000
PHX traffic	104	308.2	49.38	15,220	4,100,000
Basin traffic	219	546.7	66.58	36,395	9,800,000

- Nighttime flights only

Scenario	Number of Affected Flights	Extra Time Flown (min)	Weighted ADOC (\$/min)	Daily Cost (\$)	Estimated Annual Cost (\$)
All traffic	190	338.0	--	20,531	5,700,000
LAS traffic	64	97.0	59.13	5,735	1,600,000
PHX traffic	26	73.8	49.38	3,644	1,000,000
Basin traffic	100	169.6	66.58	11,291	3,100,000

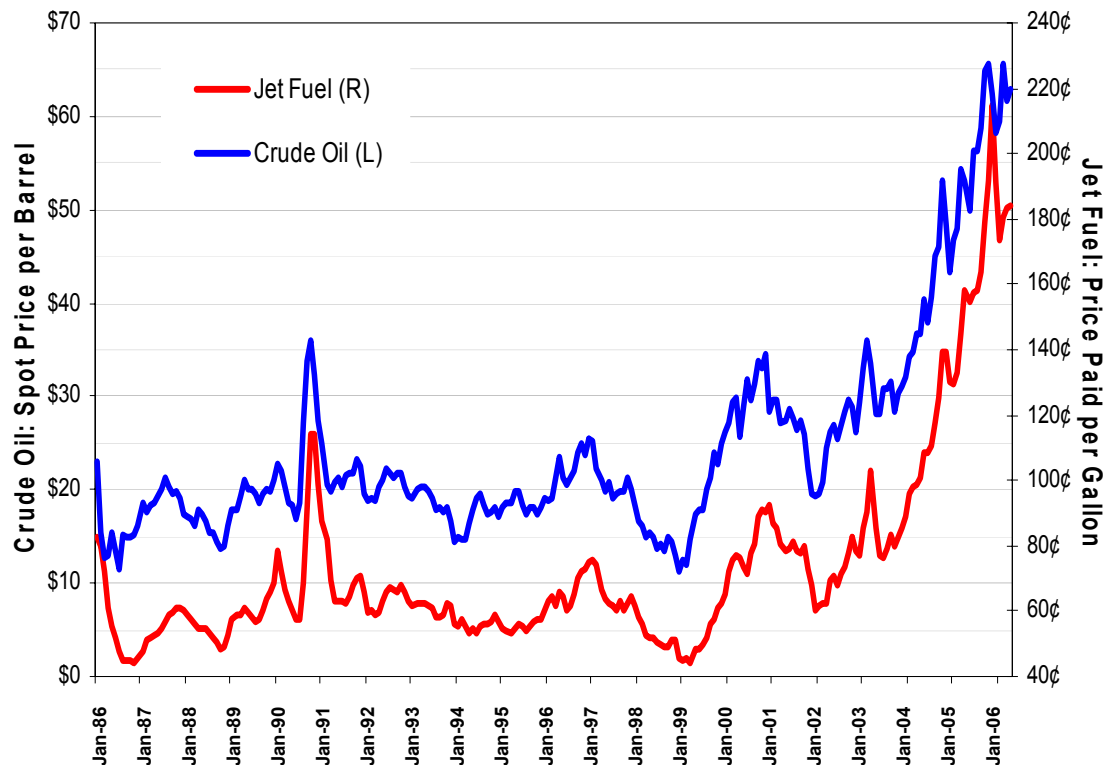




# User Cost Related to Revised Routes (continued)

- However, the future of the jet fuel prices is uncertain, so is ADOC

Average Crude Oil and Jet Fuel Prices



Data source: ATA; U.S. major, national, large regional passenger and cargo airlines; all services (last data point: Mar 06)



# User Cost Related to Revised Routes (concluded)

- If \$3.00/gallon (daytime flights only)

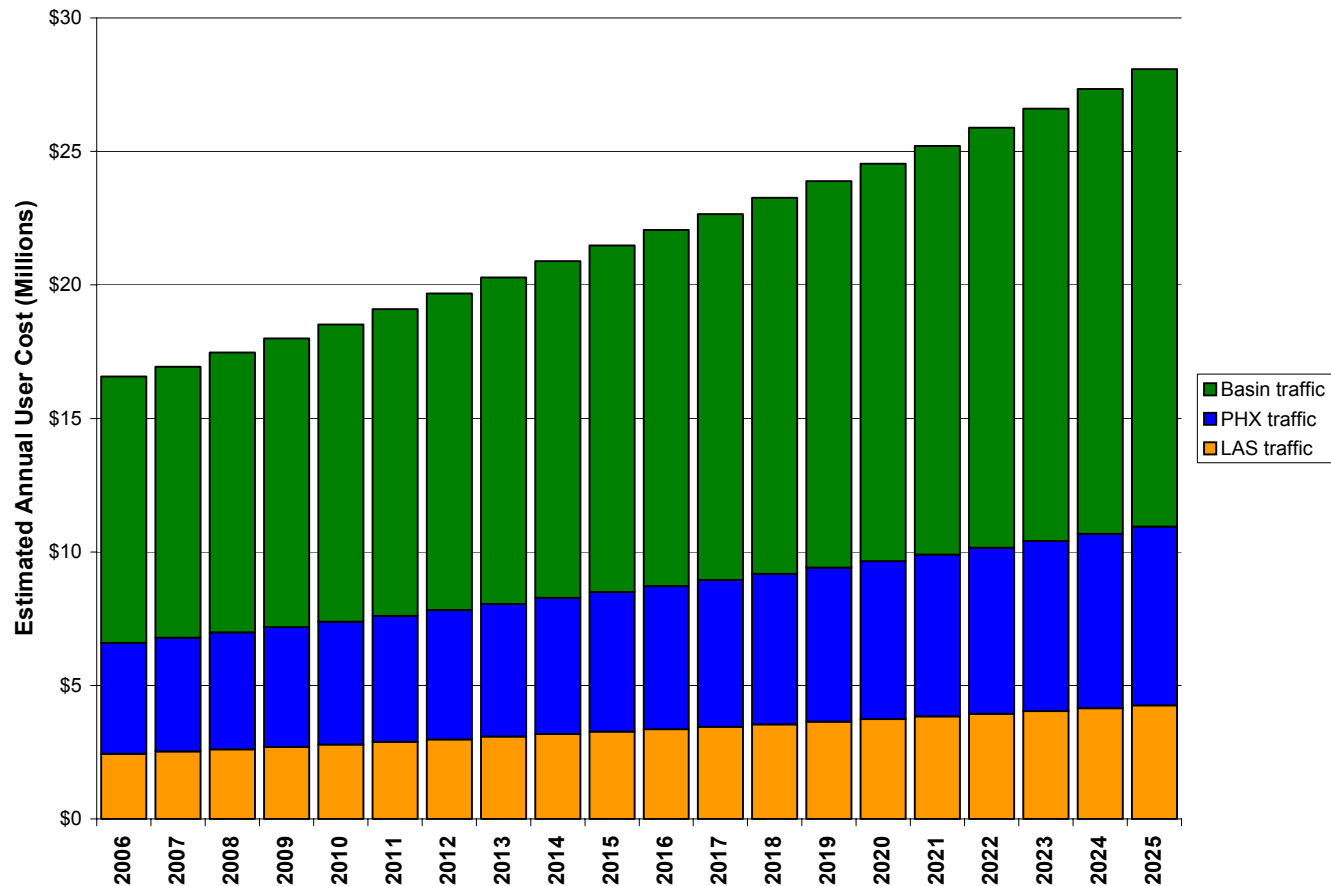
Scenario	Number of Affected Flights	Extra Time Flown (min)	Weighted ADOC (\$/min)	Daily Cost (\$)	Estimated Annual Cost (\$)
All traffic	476	1005.2	--	79,537	21,500,000
LAS traffic	136	140.5	77.42	10,879	2,900,000
PHX traffic	104	308.2	64.96	20,023	5,400,000
Basin traffic	219	546.7	87.59	47,885	13,000,000

- If \$4.00/gallon (daytime flights only)

Scenario	Number of Affected Flights	Extra Time Flown (min)	Weighted ADOC (\$/min)	Daily Cost (\$)	Estimated Annual Cost (\$)
All traffic	476	1005.2	--	98,578	26,600,000
LAS traffic	136	140.5	95.71	13,449	3,600,000
PHX traffic	104	308.2	80.54	24,825	6,700,000
Basin traffic	219	546.7	108.61	59,375	16,000,000



# Estimated Future User Costs Due to Revised Routes for Daytime Flights



- Assuming \$2.00/gallon
- Estimated future traffic levels based on FAA Terminal Area Forecasts for LAS, PHX, and LAX
- Estimated traffic level increase for impacted flights assumed to be similar to each individual airport



# User Cost Related to Potential Traffic Management Initiatives

- User Cost due to potential TMIs (daytime flights only)

Flow Affected	Restriction	Delay Incurred (min)	Weighted ADOC (\$/min)	Daily Cost (\$)	Annual Cost (\$)
LAS arrivals from SE	20 MIT	166	59.13	9,839	2,700,000
LAS arrivals from N/NE	30 MIT	529	59.13	31,297	8,500,000
LAS departures to N/NE (ground delay)	20 MIT	136	28.64	3,907	1,100,000
LAS arrivals from SE	Capped at FL320	1098	2.00	2,197	600,000
Basin departures over EED and PGS	25 MIT	37	66.58	2,463	670,000
Total Cost				49,702	13,570,000



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## Briefing Summary

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# Briefing Summary

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- **A flight-free zone over the heart of the Grand Canyon National Park (18,000 ft and above) would have a significant impact on the users of the airspace**
  - **Reroutes would add thousands of extra miles and minutes of extra flying time**
  - **Safety of the airspace and operation would be negatively impacted through increased complexity and risks**
  - **To address safety and efficiency issues, the FAA would have to take significant tactical and strategic actions**